POWER PLANT ENGINEERING

CONTENTS FOR THE MONTH OF

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VOLUME 44, NO. 10

Cover: London's famous Battersea Station, the military (?) objective of numerous Nazi air attacks on the British Capital. (Photo, Acme News Pictures.)

Back of it All 46
With the Editors 47
Chanute Field Gets Up Steam 48
Boiler Auxiliary Drives 54
The Significance of an Oil Analysis. By Harold E. Rose 57
Power Factor Improvement Pays 86 Per Cent Return. By W. L. King 60
Diesel Ice Plant Data 62
Hydrogenation of Coal 63
37,000 Volts on Motor Belt 63
Overcoming Double Frequency Vibration in Generators 64
New Wires and Cables Have Many Uses 64
Why Turbines Have Changed. By C. C. Franck 65
Industrial Fire Hazards 68
Weld Costs Per Foot. By Merrit L. Smith 69
Don't Guess—Be Sure. By B. H. Whitehouse 70
P. G. & E. Solves Industrial Problem 71
The Inspection of Wood. By W. Elwood Rossnagel 73
Sulphur as a Fuel. By Walter H. Harvey 76
Voltage Regulation On Low Voltage Electrical Circuits. By P. E. Benner 78
New Sound Meter Has 24 to 120 DB. Range 80
Light Load Diesel Pays 81
Simultaneous Firing of Gas and Pulverized Coal. By H. A. Kleinman 82
Solar Heat in Glass Houses 83
Power Plant Operation Problems. By Richard W. Crain 84
Accidents in Refrigerating Plants 86
The Practical Engineer and Electrician 87
Atomic Energy Starts New Radio Station 103
'Round About with the Electrical Editor 104
Diesel Engines Underground 106
New Equipment 107
New Orders Mark Plant Expansion 112
News from the Field 114
Helpful Bulletins 118
Productivity and National Income 126
Production Costs Rising 130
Scientists in Industry 132
Bituminous Coal Industry 134
Green Pastures 142
Student Views on Unionization 142
Octane Number 146
Steel at High Temperatures 148
Developing Factory Workers 150
New Clue for Oil Explorers 154
New Engineering Books 156
Power Plant Construction News 160

Contents of back issues of Power Plant Engineering will be found in Industrial Arts Index on file in Public Libraries.

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The most up-to-date equipment available for checking engine temperatures and performance is provided in the aisles which separate each two testing rooms at the Cummins Engine Company's new research laboratory in Columbus, Indiana. Testing engineers are provided with desks from which they can look into both testing rooms and observe the dials on which the recordings of engines on test in each can be noted. (Photo, courtesy The Austin Co.)

Back Of It All

THE PHOTOGRAPH presented above is a view in one of the testing rooms of the Cummins Engine Company's new research laboratory in Columbus, Indiana. Built by the Austin Co., this plant contains the most up-to-date equipment available for checking Diesel engine temperatures and performance. ¶ In directing attention to this latest example of progress in the Diesel engine field, we do so with a strange mixture of pride and apprehension. Our association with the power industry, naturally, makes us take pride in any advance of this type but at the same time we have misgivings. For the Diesel engine, or, more specifically, the internal combustion engine is not an unmixed blessing to civilization. While it has given us freedom from toil and the ability to travel fast and comfortably over the earth's surface, it has also made possible the unholy destruction of life and property that is now taking place across the oceans. If the internal combustion engine has made possible the automobile, the streamlined train and the airplane, it has also given us the bomber, the tank and the "mobilized equipment" of modern warfare. Think it over. What would this war be if the internal combustion engine were removed from the picture? Instantly there would be no aerial bombardment of London or Berlin in the present sense of the term. England would need have little fear of invasion. Hitler's high-speed tanks and mobilized equipment would not have been in existence to invade Poland and France and it is quite possible that there may have been no war at all. For it was the striking power of the airplane and the tank that gave Hitler his confidence. But even if there had been war, it would have been fought as wars had always been fought—bad enough, we grant, but not the horrible, soul shattering thing this is. In the ultimate analysis it probably makes little difference whether civilians or soldiers are killed, life means just as much to each, but the sheer magnitude of the conflict would be less if the theatre of war could be confined to more limited regions of the earth's surface. We won't go into this, probably the case is open to argument, but the fact remains that without the internal combustion engine, the present war would be an entirely different thing from what it is. Other factors enter the picture, or course; electrical communication, production methods, far flung power transmission systems and high explosives; all these are deadly when misused but the one thing that extends the power of them all is the development and perfection of the internal combustion engine. Over and above all, this device has given the war its present character more than any other factor.

WITH THE EDITORS

◆ **TRAMP, TRAMP, TRAMP . . .** Right or wrong America's first peacetime draft machinery is an accomplished fact. By January, the nation will resound to the tramp of somewhat over a half million armed men. By this time next year this should be swelled to around a million and a quarter including the regular army and National Guard in active service.

While the bill met considerable minority opposition in Congress it had wide popular support even from individuals belonging to organized groups lined up with the opposition. That it is an epochal departure from traditional American dependence on volunteers for peacetime military protection is not open to question. Whether it was the right course can be determined only by historians of the future.

◆ **LION AND LAMB . . .** Distasteful as the association may be to both parties, enmities have been forgotten and the lion and lamb are working together in an alliance of which the draft act is only a part of the complete national defense program.

Even a few short months ago peacetime conscription for military service would have been unthinkable, a European ism contrary to 150 yr. of American tradition. But recent events in Europe have shown that the aeroplane has wiped out our former protection of distance, and driven home the fact that no nation can have freedom and by themselves will peace.

Paradoxically any nation that wants both peace and freedom must be willing and able to fight for it, to keep outside its borders other nations which covet what the frugal and peaceful have accumulated.

◆ **THE SWISS . . .** Aggressors have existed from the dawn of history as individuals and as nations. European nations, subject to the antagonism of racial and economic differences, have long been dominated by this outside threat. The Swiss, a peace loving, industrious and frugal nation, have for many hundreds of years demonstrated to the world that a democracy is practical in spite of diverse languages and religions.

Yet at the outbreak of the war Switzerland was probably the only country in Europe not caught unprepared. Ample modern equipment, every able bodied man trained and with a rifle and ammunition in his home.

The constant threat of aggression has kept alive the spirit of William Tell, a desire for peace and a confidence in their ability to command it. This is exemplified by a story of a Swiss, reminded that his country was vulnerable because its army was only half the size of a neighbor's, "In that case," he said, "we shall have to shoot twice."

◆ **OCTOBER 16 . . .** With all this in mind some 16,500,000 young men who have had their 21 but not their 36 birthday, will register on October 16. This applies to all, citizens and aliens regardless of race, creed or color and exempts only those now in some form of military service and diplomatic corps of foreign countries. Of these every citizen or alien who has declared his intention to be a citizen is liable for 1 yr. military or naval training, again with very limited exceptions such as men with former military service and high officials of the government while they are in office.

Local boards will divide these into four groups: 1, available for immediate service; 2, deferred because of the importance to the nation for services being rendered in civilian life; 3, deferred because of dependents; 4, deferred by law or because of physical or mental unfitness.

By reducing the army physical standard of height to 5 ft., weight to 107 lb. and relaxing other provisions, the army expects to have about 5,000,000 Class 1 men in two groups. The first physically fit for regular military service; the second for limited service.

◆ **THE FISH BOWL . . .** Civilian draft boards, one for about each 30,000 population, will shuffle the registration cards, and finally give each a serial number, running from 1 up to a maximum of about 3000 for each district. Probably from the same glass bowl used in the 1917 draft, numbers will be drawn determining the order in which the registrants will be called before the board.

Sufficient Class 1 men to meet the district quota set in Washington will then be selected, collected at some concentration point with transportation and meal allowance supplied, and sent to a nearby camp. Pay for the first four months will be $21, raised to $30 for the balance of the year's service. Enlisted men's pay ranges as high as $126 per month for the highest of seven grades. Specialists ratings may also raise the base pay from $3 to $30 per mo. No men will be called until provision for proper shelter is available and the draft group at any one time is limited to 900,000.

◆ **EXEMPTIONS . . .** It is significant that there are no exemptions of registrants, simply deferment which is subject to change at any time the status of the registrant changes. Some labor union opposition arose from this point because men given deferred classification due to essential civilian service, might be reclassified immediately in case of a strike. Local boards will have wide discretion, with assistance of advisory groups and industrial advisers whose functions will be to protect essential industries.

Decisions of the board can be appealed but service or status as an officer, member, agent or employee of the Selective Service system is in itself not cause for either exemption from registration or for deferred service. Every precaution is being taken to avoid favoritism for any cause whatsoever.

◆ **ESSENTIAL SERVICE . . .** Due to current rearmament and the need for carrying on normal industrial production without throwing the nation into confusion, provision is made for "those necessary to the national health, safety or interest."

Public utilities, power plants of all industries as well as the plants themselves come within this classification but there will be no deferment of groups in any plant or industry. Each case will be handled individually and whether a man working in an essential plant is deferred depends not on the plant but upon whether or not he is performing essential service and cannot be readily replaced.

◆ **AFTER . . .** Those selected for immediate service will receive one year's training and thereafter be in the reserve for 10 yr. unless he serves two additional years in the regular military forms. Volunteer enlistments within district quotas are allowed and at present it is expected that these voluntary calls for duty will be heavy enough so that there will be no draft until after the first of the year.

Most important, however, the law specifies that employees called for military service shall be considered as on furlough or leave of absence during the period of training and will then be restored to his original status without loss of seniority or pension rights. In case this is not done provision is made for carrying the case into the U. S. District Court without cost or fee to the employee.

The law specifically states that payments to those in military service may be continued during the period of active duty and many companies have already made provision to pay all or a portion of this regular salary, during the period employees are on active military duty.

CHANUTE

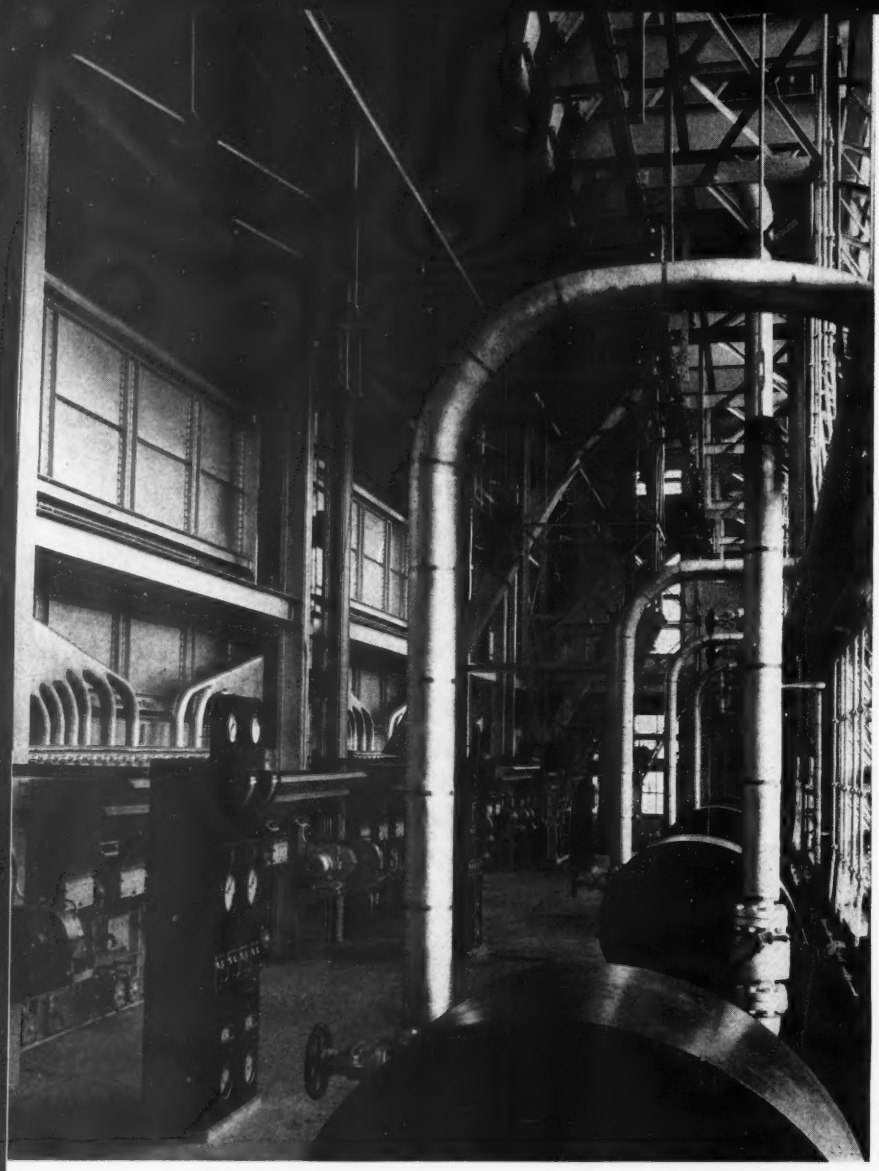


Fig. 1. General view in the new boiler plant at Chanute Field. The 5 boilers, totaling 4000 hp. rated capacity are fired by spreader stokers

WITH THE $1,800,000 four-storied barracks on Chanute Field being rushed towards completion and with new aircraft equipment arriving daily, Rantoul, Illinois, is bustling with activity and is proving a first class example of Army foresight in national defense; it makes the Middle West a center of air preparedness.

Although Chanute Field was established in 1917 as an Army Air Corps flying field, activity dwindled after the war which saved the world for democracy and a few years ago it was due to be abandoned.

That was before Mr. Hitler's blitzkrieg era, however, and now everything is changed. Today some 2800 high school graduates are being trained at Chanute Field to become master aircraft technicians. It is now entirely a ground technical school and the Army is training ground crews for the great proposed air fleet which enters so conspicuously into our national defense program.

The new barracks will house 2200 men but under pressure twice that many may be accommodated. Covering 915 acres, this air base is drawing youths from all sections of the country to join what is really the nation's most up-to-date technical school. At the time of this writing (early July) most of the boys are housed in wooden barracks or in tents, but the new permanent brick barracks will soon be finished and then they will be transferred to the new quarters. Courses in aeronautical mechanics, aircraft metalwork, radio, code deciphering, parachute rigging and a score of allied subjects are offered to the enlisted men. In the great hangars and in the modern class rooms one will find enlisted men tearing the insides out of bombing plane motors to see what makes them run and then piecing them together again.

So much for the general picture—now, you know what Chanute Field is—our purpose here is not to present a description of the field, though that is a temptation, but to describe the new boiler plant which forms an integral part of the institution.

This boiler plant will supply all the steam for heating the buildings, for heating water and for the various uses in the kitchens and the hospital. In an institution of this size, the steam requirements make for a plant of considerable size, involving in this case 3—1000 hp. and 2—500 hp. boilers, all operating at 150 lb. steam pressure and capable of delivering a total of 400,000 lb. of steam per hr. at normal rating.

As will be obvious from the accompanying photographs, the plant is a strictly modern one, generously designed as to space and completely automatic in its operation. It was designed by the office of the Quartermaster General and was built by the Dravo Corp. of Pittsburgh, Pa. Construction was started in October, 1939, and the contract was completed on June 16, 1940.

The five boilers are set in a single row with the operating floor at grade level. The two 500 hp. units are adjacent at one end, these being designated No. 4 and No. 5. These smaller units are provided largely to carry the summer load which, because of the absence of building heating requirements, is light and also to serve in cases when the load is too high for a single 1000 hp. unit but too small for two 1000 hp. units.

The general arrangement of equipment is obvious from the drawings and photographs. The boiler feed pumps, it will be noted,

FIELD GETS UP STEAM

Largest Army Technical Aviation School bustling with activity. New buildings and hangars being rushed to completion and new 400,000 lb. per hr. steam generating plant completed in June now in service.

are installed on the ground floor back of the boilers and the deaerating feedwater heater is located on a level immediately above. The water treating equipment also is located back of the boilers.

There is no basement but a trench is provided at the rear of the ashpit to permit the removal of ash from the ashpit for delivery into the ash conveying system.

The boilers are Erie City Iron Works water tube units with water cooled furnaces and arranged for recirculation of the fly ash. All boilers are fired by Detroit RotoStokers and each provided with its individual forced draft and induced draft fan. The forced draft fans are installed in front of each boiler with ducts to the stoker windboxes underneath the floor. The induced draft fans are above and at the rear of the boilers directly underneath the venturi type stacks. There is a stack for each boiler.

This arrangement of the forced draft fans is simple and provides a direct and low resistance path to the furnaces. A hand operated damper is provided for each of the separate air chambers so that the air supply through the grates can be adjusted to suit the needs of the fuel bed.

The RotoStoker, it may be explained for the benefit of those not familiar with this stoker, is a unit of the spreader type, these particular units being provided with steam operated dumping grates.

All stokers are motor driven but the forced and induced draft fans, with the exception of those on boiler No. 5, are steam turbine driven. In other words, one boiler unit (No. 5) is completely equipped for electrical operation. This not only provides means for starting up but also affords some flexibility in maintaining proper heat balance.

The forced draft fans are Green Fuel Economizer Co. units, four of which are driven by De Laval steam turbines, while the fifth, the one serving boiler No. 5, is electrically driven. The fans serving boilers 1, 2 and 3 are rated at 40,000 c.f.m. and those on boilers 4 and 5 at 20,000 c.f.m. against 3 in. static pressure.

Operation of the boilers is controlled automatically by a Bailey Meter Co. automatic combustion control system. The forced draft fans operate at constant speed but the draft supply is controlled automatically from the steam flow-air flow ratio by Bailey regulators acting on the forced draft fan dampers.

The induced fan dampers are similarly controlled as a function of the furnace draft pressure. The stoker speed is controlled as a function of the main steam pressure.

Three boiler control panels are provided. Two of these carry the instruments and control apparatus for boilers Nos. 1 and 2 and 4 and 5 respectively while the third panel (the center one) is the master control panel which in addition to the master control apparatus also carries the control and instrument equipment for boiler No. 3. These panels are located in front of the boilers in the operating aisle.

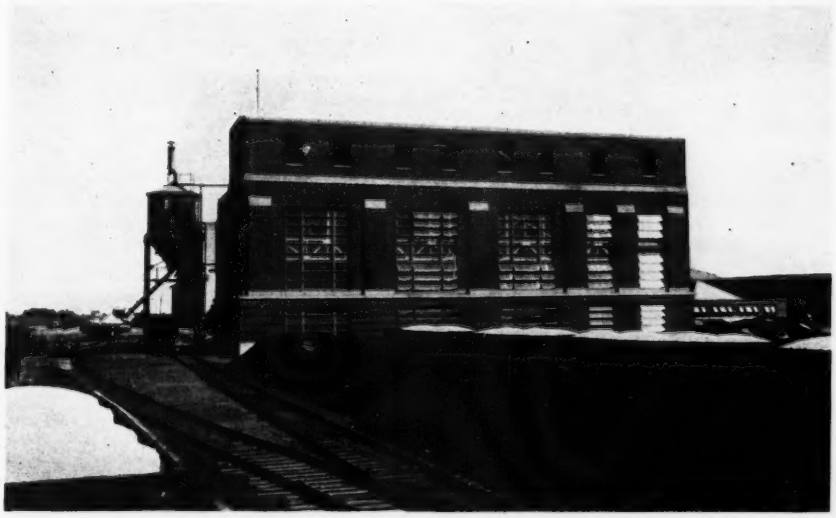
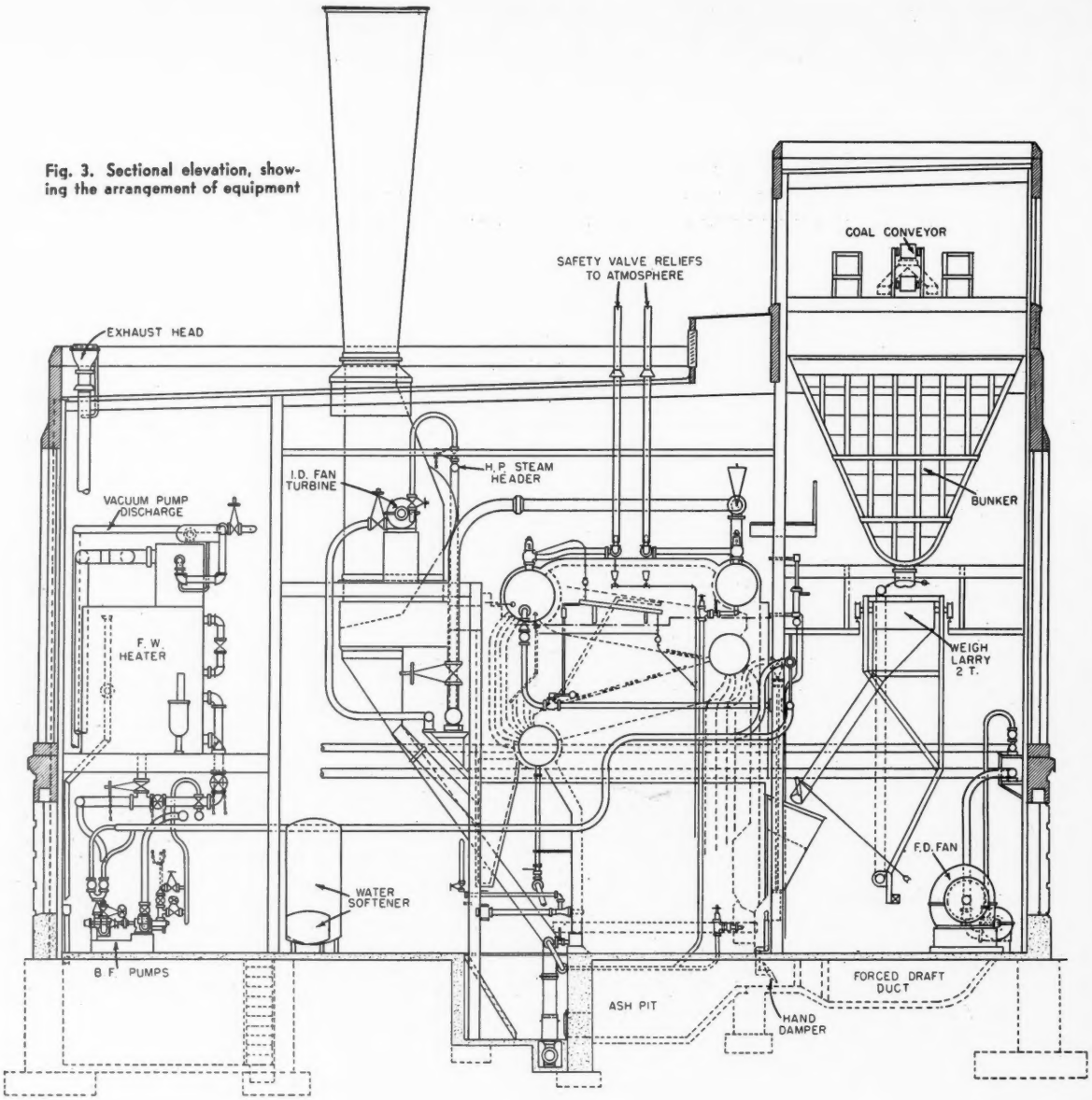


Fig. 2. An exterior view of the Chanute Field heating plant showing the outdoor ash bin at the left of the building. Note the apparent absence of stacks in this view. The stacks are short and are hidden from view by the coal handling monitor which runs the full width of the building. Coal storage in foreground

Fig. 3. Sectional elevation, showing the arrangement of equipment



The instrument equipment for each boiler included on these panels is as follows:

1 Crosby indicating steam pressure gage 0 to 300 lbs.
1 Bailey Multipointer draft gage indicating windbox pressure, furnace draft pressure and uptake draft pressure.
1 Bailey boiler meter.
2 Fan controls for the forced draft and induced draft fans respectively.
1 Ranarex CO_2 recorder.

As already mentioned, the stokers are all electrically operated. Each stoker is driven by two electric motors one at each side of the stoker and driving the units through Reeves variable speed drives. On the 3—1000 hp. boilers the stoker motors are 3 hp. General Electric motors while on the 2—500 hp. boilers 1½ hp. General Electric motors are provided. One motor is sufficient to carry full load, the second being provided as a reserve drive.

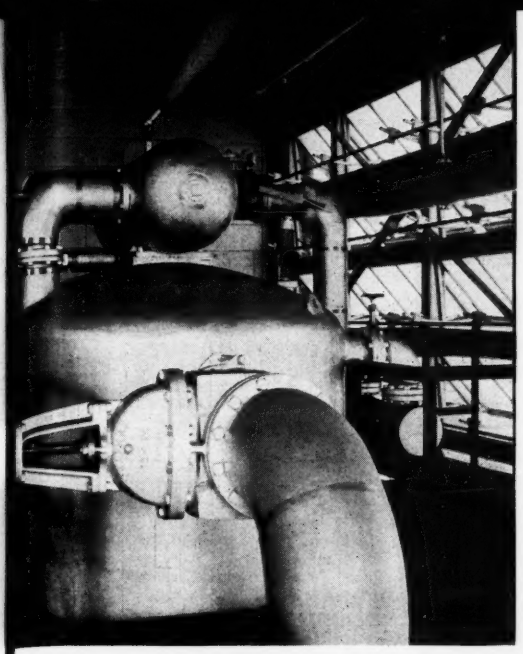
Coal Handling

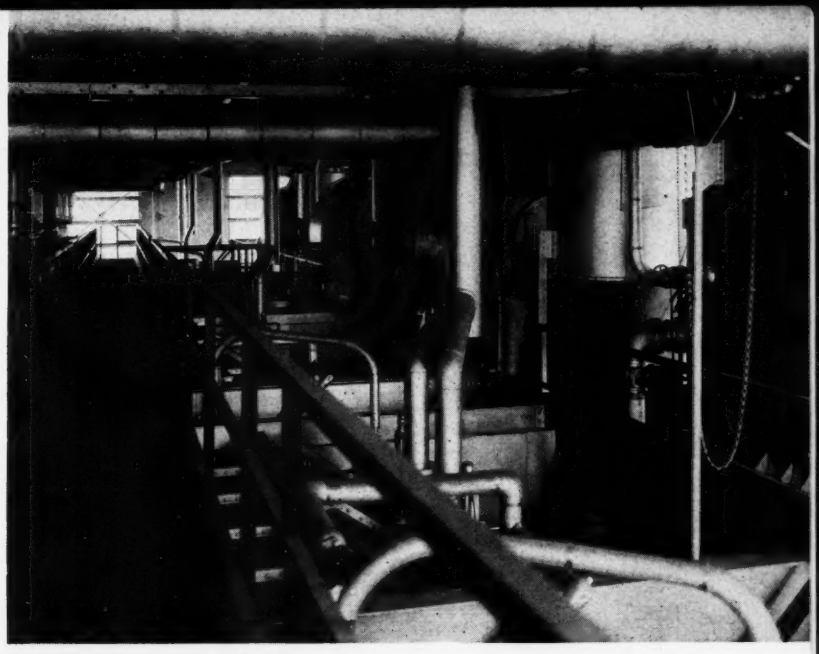
Coal brought to the plant by rail is delivered into a track hopper and thence carried to the overhead bunker in the boiler room by a Webster bucket conveyor. No crusher is provided as the coal used is entirely 1¼ in. Clinton County screenings and is of a size suitable for use on the stokers.

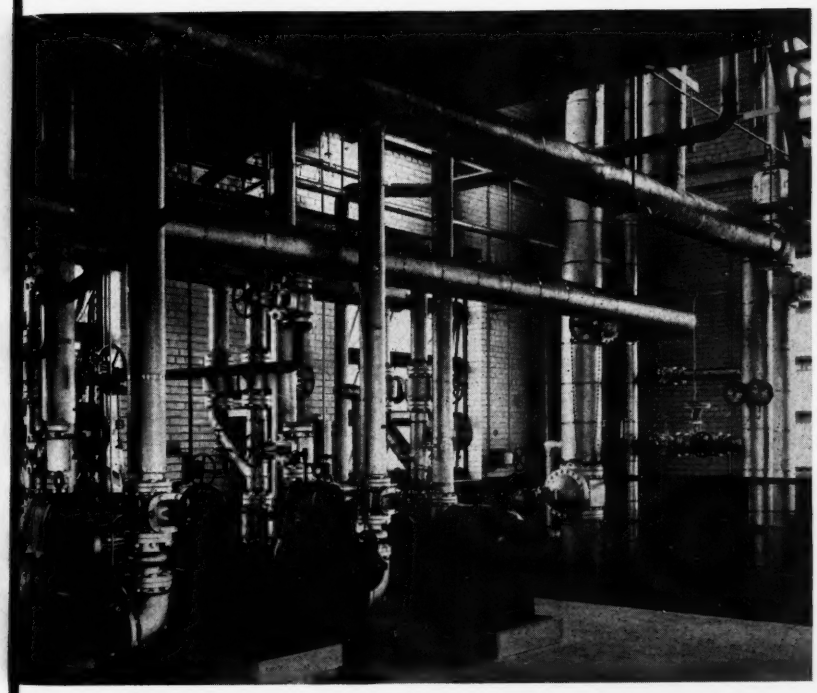
The coal bunkers are made of cast iron sections, bolted together and supported on a structural steel frame. These bunkers, which were built by the Hahn Engineering Co., have a total capacity of 925 tons. Additional storage is provided outside the plant.

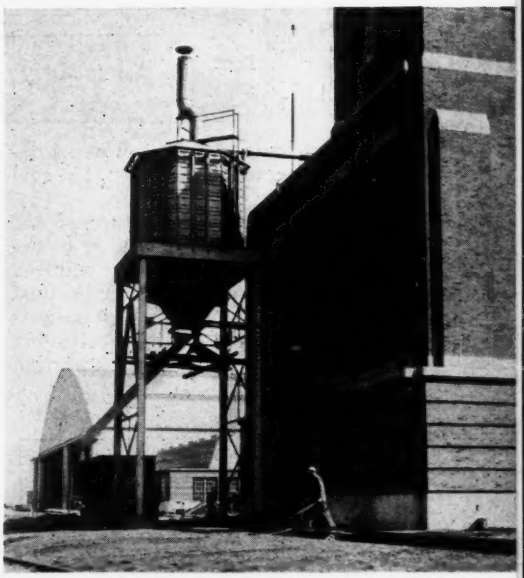
From the bunkers the coal is withdrawn by either of two weigh larries and delivered to the stoker hoppers.

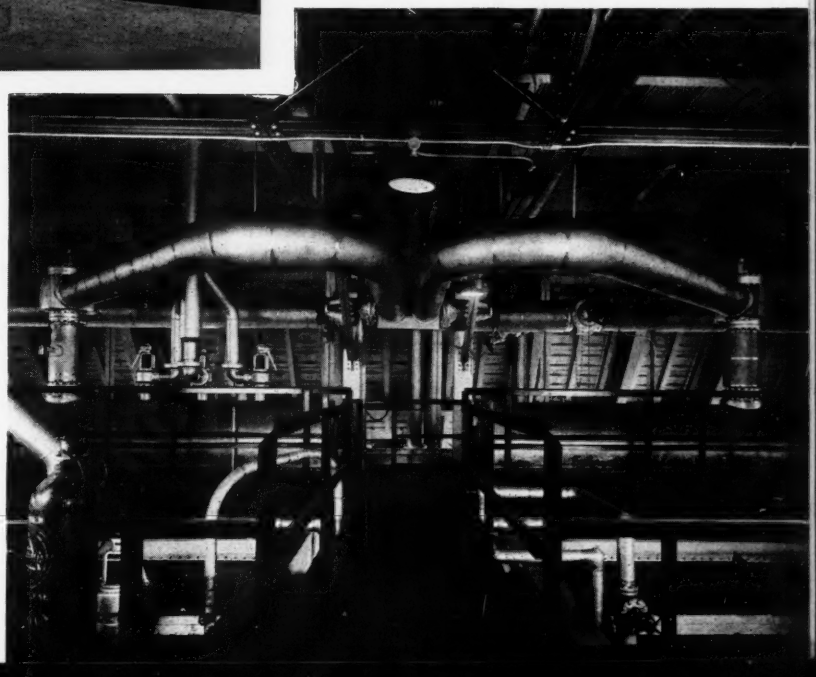
Ash is removed at the rear of the boilers and delivered to an overhead ash bin outside of the boiler house by a semi-vacuum conveying system and as in the case of the coal bunkers, this is also Hahn equipment. The ash bin









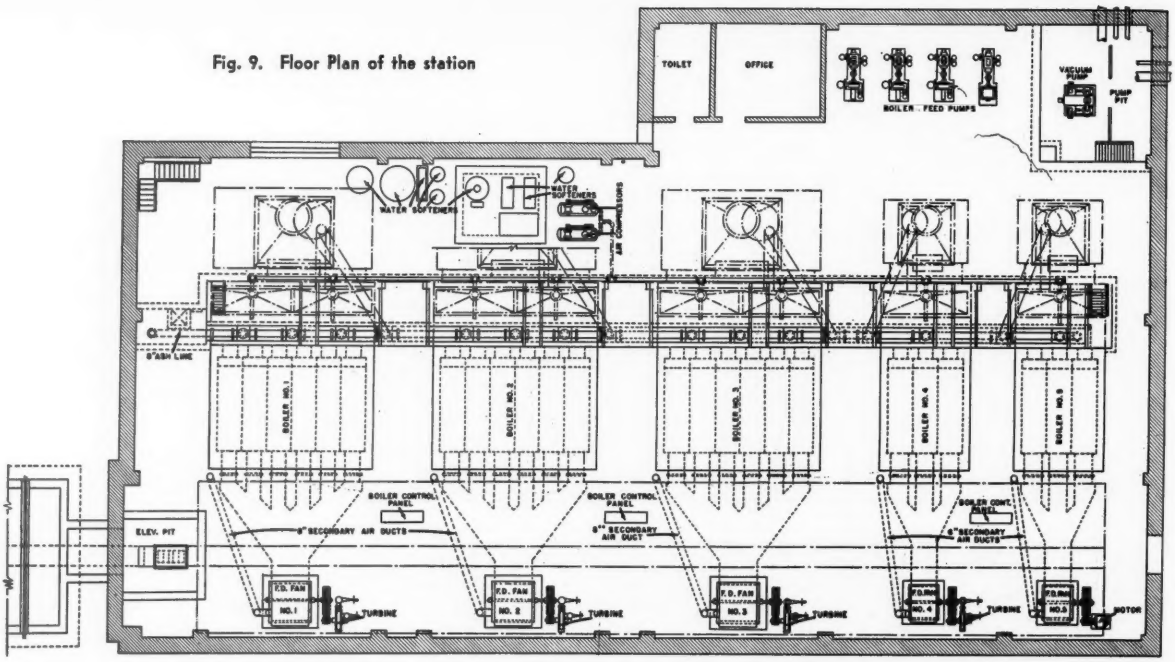


Figs. 4-8. Views of the new boiler plant at Chanute Field at Rantoul, Ill.

Fig. 4 (Upper left). A view of the top of the deaerating feedwater heater. Fig. 5 (Upper right). Above the boilers showing the induced draft fans with their associated dust collectors. Fig. 6 (Center left). Three of the four centrifugal boiler feed pumps. The one at the right is motor driven, all others are turbine driven.

Fig. 7 (Center right). The outdoor ash tank into which the ash is delivered by a semi-vacuum conveying system. Fig. 8 (Lower right). A view taken above the boilers showing the main steam headers

Fig. 9. Floor Plan of the station



is also built of cast iron and similar in construction to the coal bunkers.

An interesting feature of the installation is the handling of the fly ash and flue dust. The induced draft fans are fitted with dust collectors; the dust which collects in the hoppers of these collectors is withdrawn by the aspirating action induced by a small motor driven blower and with the same action blown into the rear of the furnace where the unburned carbon in the dust is burned. If desired, the dust can also be delivered directly into the ash pits for subsequent disposal by the ash conveying system.

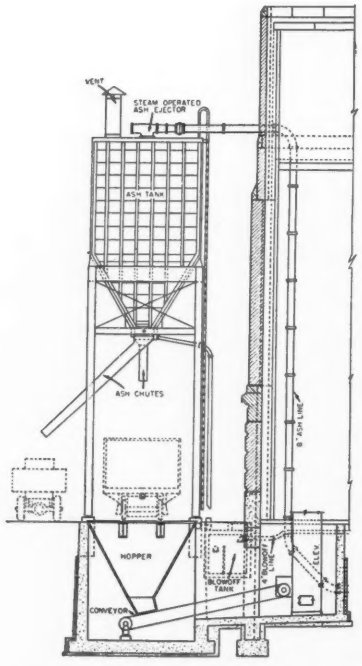


Fig. 10. Elevation of the track hopper and ash tank

Feedwater

Feedwater is obtained from deep wells. This is treated in a Permutit Zeolite Softening system using sulphuric acid to decrease the alkalinity while at the same time increasing the sulphate content. The treated water is sent to a storage tank from which it is withdrawn as needed for make-up and delivered to the deaerating feedwater heater. Returns from the heating system also drain into the feedwater heater. The boiler feed pumps take the water directly from the feedwater heater.

Four boiler feed pumps are provided, all operating in parallel so that any one or all together can supply any or all boilers.

The feed pumps are all De Laval centrifugal pumps operating at 3500 r.p.m. and designed for 125 g.p.m. under a 480 ft. head. Three of the pumps are driven by 29 hp. De Laval steam turbines while the fourth is driven by a 30 hp., 3500 r.p.m. Westinghouse induction motor.

The deaerating feedwater heater is a Cochrane unit supplied with exhaust steam from the auxiliaries and giving the feedwater a final temperature, under normal operating conditions, of 208 deg. The feedwater level in the boilers is controlled by Copes feedwater regulators.

An inconspicuous feature of the plant is the stacks; in fact, from the front of the building they cannot be seen at all. They are the Prat Daniel Thermix type, very short, extending only a few feet above the roof. From the front of the building they are entirely hidden by the monitor housing the coal conveyor.

The induced draft fans are installed in the base of the stacks. With the exception of the one fan serving boiler No. 5 which, as has already been pointed out, is motor driven, the induced draft fans are turbine driven. The three fans on the 1000 hp. boilers are driven by 90 hp. 3190 r.p.m. De Laval turbines through reduction gears, the latter having a 4.15 speed ratio. The induced draft fans on the 500 hp. boilers are driven by a 37 hp. turbine and 40 hp. motor respectively.

The plant is attractive in appearance both inside and out and its ample proportions provide a maximum of operating convenience. Piping throughout is all welded, extra heavy and well insulated. The effectiveness of the insulation is reflected in the necessity for the use of unit heaters in the boiler room. Two "Carrier" Heat Diffusing units are installed

(Continued on Page 56)

List of Principal Equipment at the Chanute Field Heating Plant

General

Name—Chanute Field Heating Plant
Location—Rantoul, Ill.
Owners—U. S. Army
Designers—Office of the Quartermaster General
General Contractors—Dravo Corp., Pittsburgh, Pa.

Boiler Equipment

BOILERS. 5 Erie City Iron Works, bent tube, built for operation at 150 lb. gage and having water cooled furnaces. These units are of two sizes, rated as follows:

3—1000 hp. units each with 10,000 sq.ft. H.S. in the boiler and 2510 sq.ft. H.S. in the water walls. Steaming capacity 100,000 lb. per hr. each. Furnace volume 4400 cu.ft. Grate area, 252 sq.ft.

2—500 hp. units, each with 5000 sq.ft. H.S. in the boiler and 1740 sq.ft. in water walls. Steaming capacity 50,000 lb. per hr. Furnace volume 2150 cu.ft. Grate area, 126 sq.ft.

STOKERS. 5 "Roto Stokers" with steam operated dumping grates built by Detroit Stoker Co., each driven by two General Electric Co. induction motors through Reeves variable speed drives. Each motor on the 1000 hp. units is rated at 3 hp. Each motor on the 500 hp. units is rated at 1½ hp.

FEEDWATER REGULATORS. "Copes" feedwater regulators on all boilers by Northern Equipment Co.

SOOT BLOWERS. The Bayer Co.

GAGE COLUMN. The Reliance Gauge Column Co.

SAFETY VALVES. "Consolidated".

BLOW-OFF VALVES. Combination units consisting of 1 Yarway "seatless" and 1 Yarway double tightening valve. Yarnall-Waring Co.

Draft Equipment

FORCED DRAFT FANS. 5 Green Fuel Economizer fans in sizes as follows:

3—40,000 c.f.m., 3 in. S.P., driven by De Laval Steam Turbine Co. turbines rated at 40 hp., 1260 r.p.m. and operating at 150 lb. steam press., 10 lb. back pressure.

2—20,000 c.f.m., 3 in. S.P., one driven by a 17 hp., 1170 r.p.m. De Laval turbine and the other (on Boiler No. 5) by a 20 hp. Westinghouse motor through a Falk "Steelflex" coupling.

INDUCED DRAFT FANS. 5 Prat-Daniel Thermix with Thermix Recirculator Dust Collectors with drives as follows:

3—driven by 90 hp., 3190 r.p.m. De Laval steam turbines through De Laval reduction gears with a 4.15 gear ratio.

1—by a 37 hp., 860 r.p.m. De Laval turbine with 3.81 gear ratio reduction gear.

1—by a 40 hp. Westinghouse motor with De-Ion starter.

FAN ON RECIRCULATING DUST SYSTEM—Buffalo Forge Co. STACKS—"Thermix" by Prat-Daniel Co.

Coal and Ash Handling

COAL HANDLING. System consisting of track hopper, bucket conveyor and weigh larries. Webster.

COAL CONVEYOR DRIVE. Master Electric Co. 30 hp. induction motor with Falk reduction gear.

OVERHEAD COAL BUNKERS. 925 t. capacity sectional cast iron supported on structural steel. Hahn Engineering Co.

ASH CONVEYOR. Semi-vacuum system. Hahn Engineering Co.

ASH STORAGE TANK. Sectional cast iron. Hahn Engineering Co.

Combustion Control

COMBUSTION CONTROL SYSTEM. Bailey Meter Co. Consists of complete control for 5 boilers. It includes 3 boiler control panels, two of which contain the control and instrument equipment for two boilers each and the third is the master control panel, which also contains the control and instrument equipment for the 5th boiler. Instrument equipment for each boiler is as follows:

1 Crosby steam pressure gage, 0-300 lb. gage.

1 Bailey Multipointer Draft Gage, showing windbox pressure, furnace pressure and uptake draft.

1 Bailey Boiler Meter.

1 Set of F.D. and I.D. fan controls.

1 Permutit "Ranarex" CO_2 recorder.

Feedwater Equipment

DEAERATING FEEDWATER HEATER. Cochrane Corp.

BOILER FEED PUMPS. 4—De Laval centrifugal pumps, 3500 r.p.m., 480 ft. head, 125 g.p.m. Three of these units are driven by 29.1 hp. De Laval steam turbines and the fourth by a 30 hp. Westinghouse motor.

FEEDWATER TREATING SYSTEM. Zeolite with acid. The Permutit Co.

ATMOSPHERIC EXHAUST VALVE. Cochrane Corp.

Heating System

VACUUM PUMPS. 2—C. A. Dunham, vacuum return line pumps each capable of handling 65,000 sq.ft. radiation.

UNIT HEATERS. The Carrier Engineering Co.

Miscellaneous

AIR COMPRESSORS. 2—Ingersoll-Rand, 2 stage self-contained units with receiver and driven by 16 hp. Westinghouse motors.

VALVES AND FITTINGS. Chapman Valve Mfg. Co., Crane Co.

MOTOR CONTROL EQUIPMENT. Westinghouse, Cutler Hammer, Colt's Patent Fire Arms Mfg. Co., Square D Co.

REGULATING VALVES ON MAIN STEAM LINE. Ruggles-Klingemann Mfg. Co.

PAINT. Sherwin-Williams Co.

Sub-Contractors

Brickwork—F. C. Rowley and Sons, Hammond, Ind.
Plumbing—Katz, Cutler and Price, Chicago, Ill.
Boiler erection—American Boiler & Tank Co., Chicago, Ill.
Boiler setting—Peter Knowe & Sons, Chicago, Ill.
Roof—American Federal Cement Tile.
Glazing—Stewart Carey Glass Co.
Louvres—American Protective Metal Co.
Structural steel erected by Duffin Iron Works, Chicago, Ill., and Kenwood Erection Co., Chicago, Ill.
Insulation—Asbestos Asphalt Insulating Co., Chicago.
Electrical work—Allegheny Electric Co., Pittsburgh.
Window sash and doors—Truscon Steel Co.
Piping—Dravo Corp.

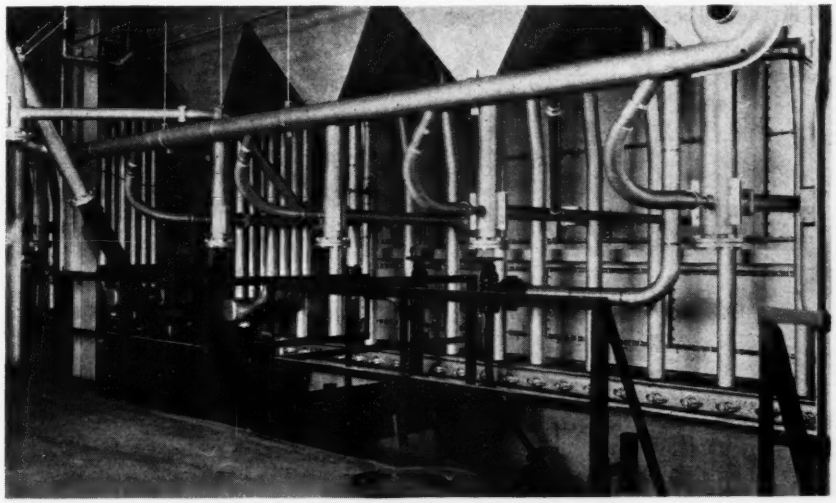
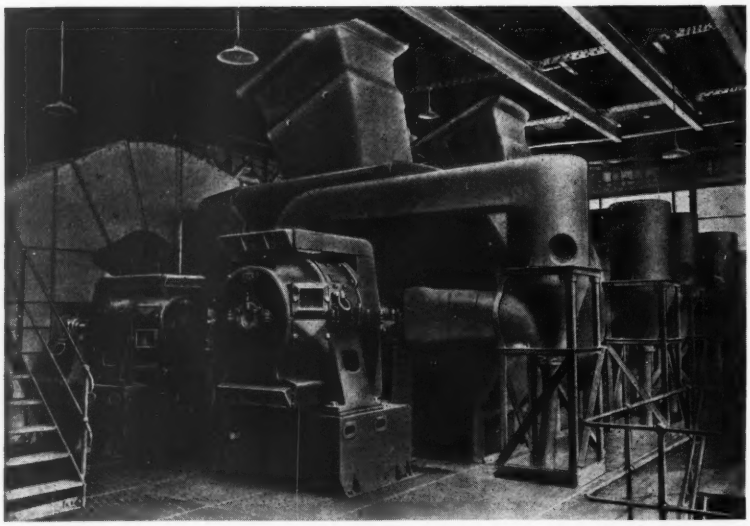


Fig. 11. A view at the rear of the boilers showing the dust collection hoppers and the pneumatic system provided for re-circulating the flue dust



New British system of d.c. auxiliary drive offers the utmost in flexibility at a cost said to be competitive with the older and more common arrangements. Installation at Brimstone A Power Station demonstrates the simplicity and flexibility of the arrangement

Boiler Auxiliary Drives

SINCE the introduction of the extraction cycle motor driven auxiliaries have become increasingly popular with the constant speed line start induction motor the prime favorite because of its low cost, simplicity and reliability. As the demand for part load efficiencies increased, the need for variable speed drives in large sizes has been met largely by hydraulic couplings or two speed motors, with isolated installations of the electronic control and magnetic coupling. In spite of its advantages, use of the direct current in large size motors is infrequent, the isolated exception in the utility field being the Detroit Edison Co. which uses it extensively in its stations for auxiliary drives supplied from a house generator.

For this reason the new electric drive system developed by Metropolitan Vickers and known as the Metrovic Unified boiler control is of unusual interest. It combines the maximum of flexibility and simplicity in a d.c. drive system which gives control from a panel of: the plant as a whole; any boiler as a unit; or any individual auxiliary. It thus approximates what in this country is known as semi-automatic control or remote positioning. The system can be provided with full automatic control if desired but so far this has not been done.

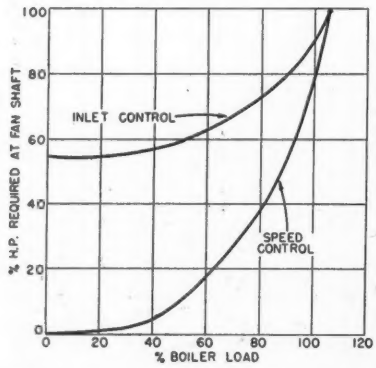


Fig. 1. Curves showing the difference in power consumption of fan drives for two methods of control

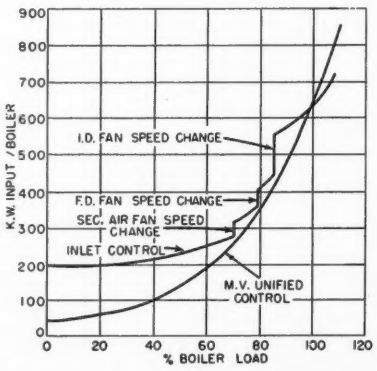


Fig. 2. Auxiliary energy consumption using two speed a.c. motors and fan inlet control compared with the consumption of the Metrovic Unified control. Estimates for a two speed drive with hydraulic couplings falls between the two solid curves at extreme load, closely approximate the upper curve down to about 70 per cent where it breaks off and joins the lower curve at about 30 per cent load

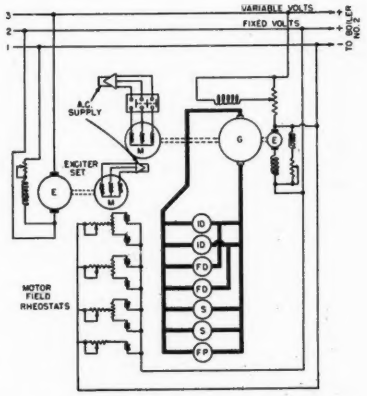


Fig. 3. Schematic arrangement of the control on one boiler at Brimstone. Forced and induced fraft fans on each boiler are arranged in two pairs with a common overload trip for each pair so that if one fan trips out its companion will follow

Advantages of variable speed are concerned primarily with the reduction of auxiliary power at low loads and this savings is apparent from Fig. 1. These and other curves are based on estimates made by the company. Figure 2 shows estimates of auxiliary energy requirements in kilowatts per boiler with fan inlet and two speed motor control and with variable speed control. The two speed motor shows

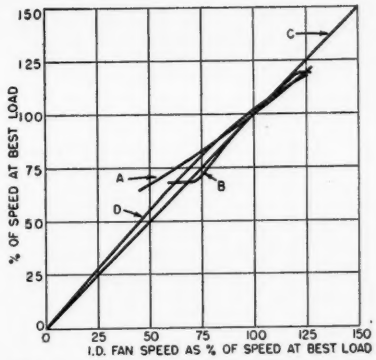


Fig. 4. Curves showing the characteristics changed by compounding to give inherent regulation. A, relation between forced and induced draft fan. B, relation between stoker speed and induced draft fan. C, speed characteristic of a motor with constant shunt field with the supply voltage varied to meet the induced draft fan. D, effect of compounding to bring curve C into closer agreement with curve A

a considerable saving over single speed drives but is still considerably above the requirements for variable speed.

The fundamentals of the new Unified control is shown by Fig. 3, a diagrammatic representation of the system as used at Brimstone Power Station. This consists essentially of continuous current motors driving the fans, stokers and boiler feed pump, with the motors grouped in boiler units and the output of each group controlled by means of a variable voltage supply. Individual control is obtained by field weakening of the motors. Changes in the relationship of one to another for change of output is obtained by designing the inherent regulation of each in accordance with the requirements of the system.

The fields of the motors are supplied from exciters coupled to the motor generators and are paralleled via busbars 1 and 2. The ratios of the speeds are controlled by adjusting the field rheostats, the actual speeds being fixed by the voltage supplied from the generator. All generator fields are supplied from exciter busbars 1 and 3, and if it is desired to raise or lower the steam production of any one boiler, the field rheostat of the generator of that boiler is adjusted, altering the terminal voltage of the generator. The excitation busbars are fed from a small exciter set, connected to the station battery and complete control of the output of the bank of boilers can be achieved by adjusting the voltage of this small exciter set.

This installation in more complete form is shown by Fig. 5, and the installed control panel by Fig. 6. The primary turbine is supplied with steam from two boilers and each of these boilers has its own auxiliary generator coupled through gears to the main low-pressure turbine shaft. A central handwheel on the master control panel regulates the field of a small booster, which, by determining the field strength of the d.c. generators, controls the output of the boiler house. Each boiler has a main controller regulating the field strength of its own generator. These generators feed the armature circuits of the fan, stoker and feed-pump motors, each of which is provided with a rheostat in its field circuit for adjusting the auxiliaries individually.

With the arrangement described, it is possible for the firemen in charge of the individual boilers to adjust the induced and forced draft fans so that each furnace is burning with the best possible air and fuel distribution. On the other hand, if the combustion engineer wishes to raise the steaming of one boiler, it is not necessary to alter the setting of the individual fan motors, but only to adjust the field rheostat on the generator.

High breaking capacity switchgear is reduced to a minimum, as there is only one such switch for each boiler, feeding the a.c. motor of the motor generator set, and in the case of generators driven from prime movers, no a.c. switchgear is required.

Control gear and starters are also reduced to a minimum, as the individual direct current machines can be brought up to speed by raising the voltage of the motor generator sets. To re-start a motor, it is usually possible to reduce the voltage of the d.c. generator for a brief period to some value which will allow a machine to be switched direct into circuit. It should be noted that there are no heavy current circuits to be broken and all control is done by light current shunt rheostats.

Should it be desired to change the source of coal supply, it is possible to do this without any radical alterations to any of the plant in the boiler house. It is only necessary to obtain the optimum settings of the various auxiliary units. Adjustment of air pressures is carried out by balancing resistance in the field circuits which are normally

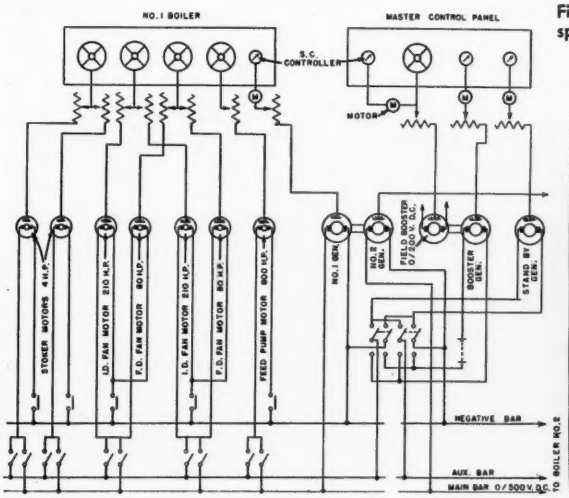
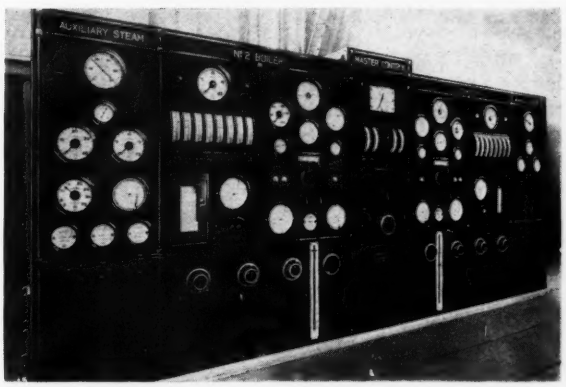


Fig. 5. (Left) Complete schematic diagram of boiler auxiliaries and speed control for a two boiler plant. Boiler No. 2 has been omitted

Fig. 6. (Below) The control board at Brimstone with the master panel in the center, one boiler panel at each side of it and an auxiliary service panel at each end



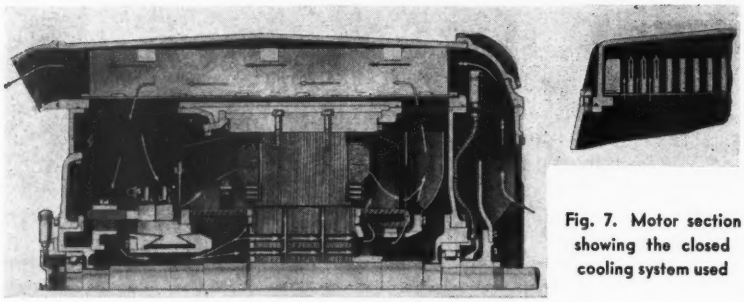


Fig. 7. Motor section showing the closed cooling system used

set before the boiler goes into commission, and should unbalancing develop for any reason, it is a comparatively simple matters to re-set these resistances.

Curves A and B in Fig. 4 show typical relations between forced and induced draft fan speeds, and stoker drive and induced draft fan speeds, respectively. With the supply voltage to the driving motors controlled to suit the induced draft fans, it is obvious that curve C would represent the speed characteristic of a motor with constant shunt field. Considering the stoker speed characteristic curve B, it will be observed that over the normal working range (75 per cent to 125 per cent of induced draft fan speed), the maximum difference between this curve and curve C is only of the order of 4 per cent, so that with the supply voltage controlled to give the desired induced draft fan speed characteristic, the stoker motors will also inherently give their desired speed characteristic with a maximum error of only 4 per cent.

In the case of the forced draft fan speed characteristic curve A, however, the difference between this curve and curve C is of a higher order. By compounding a motor, the speed characteristic with constant shunt field can be changed from that shown by curve C to that shown by curve D. Over the normal working range, curve D differs from curve A by a maximum of the order of only 2 per cent, so that by the introduction of compounding, with the supply voltage controlled to give the desired induced draft fan characteristic, the forced draft fan motors will also inherently give their desired speed characteristic with a maximum error of only 2 per cent.

Hence, for all practical purposes, the desired relative characteristics of induced and forced draft fan motors and stoker motors can be obtained, over the normal working range, by one control, that of supply voltage, and only small individual shunt field adjustments will be necessary for extremes of load and abnormal conditions.

A photograph of the fan floor of the station is shown at the beginning of the article. The motors used are totally enclosed with the details of the cooling system shown by Fig. 7. Double headed arrows denoting the external air-circuit and single headed arrows the internal air-circuit. The two-circuit system of cooling gives the valuable advantage that the external dust laden air is entirely excluded from the interior of the motor, while the closed circuit of the air within the motor ensures efficient cooling.

Paths of the air through the radiators are free from sharp bends, and the air is forced along them at a high velocity to prevent precipitation of dust. If cleaning should become necessary, due to exceptional causes, this can be carried out through the inspection cover. By deflecting the air downwards at the outlet end of the radiators, drafts are eliminated and people working near the machine are not tempted to block up the outlet to avoid discomfort.

In regard to cost, the company says the Unified system is comparable with any existing equipment, since the savings in switchgear, cables and mechanical change speed gear, etc., more than offset the slightly higher cost of the d.c. motors even with a motor generator set for each boiler. A total cost of £6600 (about $21,100 at present rate of exchange $3.20 per £) was estimated for a 200,000 lb. per hr. boiler, as against other types of equipment varying between £6500 and £7500. ($20,800 and $24,000). The problem of making truly comparable cost schedules is rendered difficult by the present practice of sectionalizing inquiries so that each part is dealt with individually.

This means that increased costs in one section which gives a lower total cost may be misinterpreted and possible actual savings overlooked. It would be a distinct advance on present practice to consider the auxiliary system as a whole and design this in the early stages of any new power station project. When treated in this manner it is claimed that the Unified system of control shows advantages in reliability, ease of control, efficiency and, in many cases, initial cost.

Chanute Field Gets Up Steam

(Continued from Page 52)

in diagonally opposite corners of the building. A small heater is also installed in the chief engineer's office.

The heating system is provided with two Dunham vacuum return line pump units. These are installed in a pit about ten feet below the operating floor. Each of these has a capacity of 97 g.p.m. and is capable of handling some 65,000 sq.ft. of radiation.

Compressed air for general use in the plant is supplied by two self-contained 2 stage Ingersoll-Rand motor driven compressors each with its own receiver and operating under automatic control.

The building is of brick and steel construction with a cement tile roof. Everything inside the plant, including all structural steel, as well as the boiler casings and all piping, is painted with aluminum paint.

While the plant has not been in operation long enough to present any operating records, it is of interest to point out that in the acceptance tests the overall efficiency of the plant was well in excess of the 76 per cent specified in the contract.

The purpose of this plant as indicated at the beginning of this article is primarily to supply steam for heating. Distribution throughout the grounds is at boiler pressure (150 lb.) and the pressure is reduced to proper values at the various points of service. Steam distribution is underground.

The Significance of an Oil Analysis

A concise and simple explanation of the meaning of various chemical and physical properties of oil, how they are determined, what relation they have to service conditions and how the properties are influenced by the field from which the oil comes. This article* discusses gravity, flash and fire points, viscosity and viscosity index, water and sediment

By Harold E. Rose

EFFICIENCY of mechanical operations is largely dependent upon correct lubrication and the power plant and power applications with a variety of equipment offers numerous problems. There is prevalent a rather general impression that laboratory methods will evaluate the suitability of an oil for a specific condition. While it is true that an anlysis will reveal the chemical and physical properties of a petroleum product, such an examination will not always indicate the applicability of a particular product to a given requirement. Test methods offer their greatest usefulness to the consumer as a means of checking the uniformity of petroleum products specified.

Selection of a proper lubricant is further complicated by the fact that quality is determined by many factors, some of which may not be understood or are not commonly specified. Additional factors may include incomplete knowledge relative to service requirements, reactions to heat and pressure, intangible properties such as oxidation, sludge formations, film strength requirements, et cetera, and the relationship of specified properties to service conditions.

Answers to these and many other questions are the stumbling blocks to the digestion of test methods. The ability to interpret an oil analysis is essential to the understanding of proper application of lubricants and is of untold value in the purchase and selection of these materials. The "hit or miss" procedure of past years are not justified in this era of mechanical efficiency. Correct lubrication is a medium which affords reduced maintenance costs, increased power output, and greater longevity of the equipment. No attempt will be made to discuss the more technical phases of laboratory methods. Rather, a brief explanation will be given as to the significance of standard methods employed in the evaluation of petroleum materials.

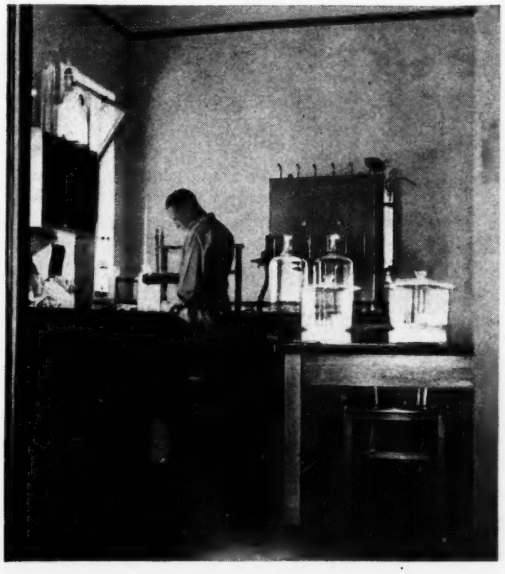


Fig. 1. A laboratory can be made an asset to any plant but should be arranged to meet individual needs. Laboratory needs may range from a simple $25.00 kit for simple water tests to a complete chemical and physical laboratory equipped to make fuel and oil tests. Much of the equipment is expensive and requires a trained laboratory technician so many plants find it desirable to have much of this work done by an outside commercial laboratory.

Gravity

The specific gravity of an oil is the ratio of its weight to that of an equal volume of water, the accepted temperature for such a comparison being 60 deg. F. One of two methods is customarily utilized in this determination (1) specific gravity or (2) A.P.I. gravity (American Petroleum Institute scale). As defined, specific gravity is expressed as a ratio. For example, if a given oil weighs 50 lb. per cu. ft. at 60 deg. F., its specific gravity would be 50 divided by 62.3 (wt. one cu. ft. water) or 0.803. The A.P.I. scale is based upon the following expression: (A.S.T.M. 287-39)[1]

$$\text{A.P.I. degrees at 60 deg. F.} = \frac{141.5}{\text{sp. gr. at } 60^\circ \text{ F.}} - 131.5.$$

The above oil, with a specific gravity of 0.803 converted to degrees A.P.I. is thus:

$$\frac{141.5}{0.803} - 131.5 = 44.7.$$

Gravity determinations are readily made by the use of a hydrometer,[2] so calibrated that the A.P.I. readings are taken directly from the scale. Available instruments have a built-in thermometer and they are relatively inexpensive.

Gravity determinations are of no value in judging the quality or suitability of an oil, but, to an experienced engineer, it will indicate the probable crude from which the oil was processed. In general, the specific gravity of a paraffin-base oil is less than 0.90 (greater than 25.7 on an A.P.I. scale). An intermediate or mixed base oil between 0.90 and 0.91 (24.0 and 25.7 A.P.I scale) and that of a naphthene base is greater than 0.91 (less than 24.0 on an A.P.I. scale).

[1]EDITOR'S NOTE: Detailed laboratory equipment and test procedure is included in the A. S. T. M. standard methods of test indicated in parenthesis throughout the article. These may be found in Part III of the bound volume of A. S. T. M. Standards—1939. Individual copies of each standard can also be obtained for 25 ct. per copy from the American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa. They may be ordered by the designation number given in the article. These standards are identical with those adopted by the American Standards Association and the American Petroleum Institute but each society uses a different designation.

[2]EDITOR'S NOTE: The hydrometer used is similar to the ones commonly used in automobile service stations for determining the charge of an electric storage battery, where the charge is proportional to the specific gravity of the acid.

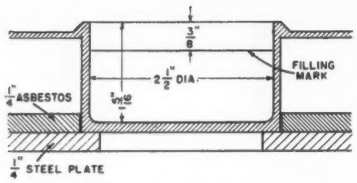


Fig. 2. The Cleveland Open Cup for determining flash and fire points for all petroleum products except fuel oil and those having an open cup flash below 175 deg. F. The oil is heated in this cup, on a special plate, at a uniform rate. The flash and fire points determined by applying a small test flame. The flash may appear momentarily at any point in the cup. For the fire point the oil must ignite and burn at least 5 sec.

Gravity also serves as a check on the uniformity of a product.

The B.t.u. content of a fuel oil may be approximated from the gravity by use of the following formula:

B.t.u. per lb. of oil
= 18,700 + 40 (A.P.I. gr. — 10)

Assuming a 20 A.P.I. gravity fuel oil were used for a hypothetical computation, we find:

18,700 + 40 (20-10)
= 19,100 B.t.u. per lb.

Flash and Fire Points

Originally the purpose of the flash and fire points was to determine the possible fire hazards attached to the storage and transportation of petroleum products. Such information is of importance to users of kerosene, gasoline, fuel oils and the lighter products, but is of no significance when applied

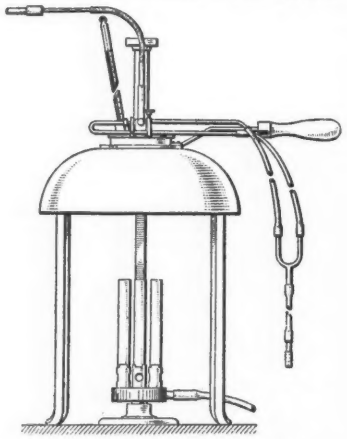


Fig. 3. The Pensky-Martens tester for determining the flash point of fuel oil. While the cup is covered, the test procedure is similar to that of the open cup except that the heat is applied by means of an air bath

to lubricating oils whose flash points usually are well beyond those in hazardous classifications.

Determination of these points involves the heating of a specified quantity of the sample to a temperature at which the oil produces sufficient vapor to become momentarily ignited when subjected to a small flame. The temperature at which the continued heating of the sample produces sufficient vapor to cause the oil to burn continuously is considered the fire point. There are several recognized methods for these determinations, namely Cleveland Open Cup, (A.S.T.M. D92-33)[1], Penskey-Martens Closed Cup (A.S.T.M. D93-36)[1] and Tag Closed Cup (A.S.T.M. D56-36)[1]. The first named is employed for lubricating oils while the latter two find use in determinations involving volatile liquids such as gasoline, kerosene, and allied products.

Results obtained from flash and fire determinations are of little value in estimating the quality of a product. They offer some information relative to the uniformity of a product and will indicate contamination by low-flash materials. Generally, evaporation in service is more rapid with oils of low flash points than with those products whose flash points are high. Oils processed from paraffin-base crudes have a higher flash and fire point than those of naphthene-base origin.

Viscosity

Viscosity is probably the most important single property of a lubricating oil, as it is that characteristic which tends to prevent metallic contact between bearing surfaces. Actually, viscosity is a measurement of the internal resistance of a liquid to flow. Liquids which flow rapidly are said to have a low viscosity, while fluids which move slowly are referred to as viscous materials. The viscosity of an oil, therefore, is a measurement of its fluidity. It is determined by observing the number of seconds required for a given quantity of oil at a predetermined temperature to flow through a standardized orifice[3].

Oil is said to have a viscosity of 150 at 100 deg. F., that is, it requires 150 seconds for 60 c.c.'s (approx. 2 oz.) of the oil to flow through the standard orifice at a temperature of 100 deg. F. The standard instrument in the United States employed for viscosity determinations is the Saybolt Universal Viscosimeter (A.S.T.M. D88-38)[1]. Normally, only three standard temperatures are used: 100, 130 and 210 deg. F. By use of a suitable chart (A.S.T.M. D341-39)[1], the viscosities ranging from minus 30 to 450 deg. F. can be estimated if the viscosities at any two temperatures are known. Such information is of value where equipment operating over a wide range of temperature is functioning.

A perfect petroleum product, as concerns lubrication problems, would be one which had the same viscosity at all temperatures. No

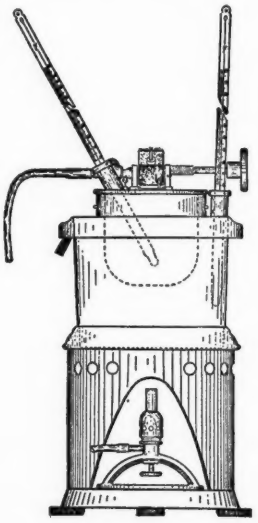


Fig. 4. The Tag closed tester for determining the flash point of mobile liquids flashing below 175 deg. F. The heat is applied to the cup in this case through a water bath.

such oil exists; all thin out at high temperatures (reduce their viscosity) and thicken at low temperatures (increase their viscosity). Since all oils do not vary the same in a given temperature range, the term Viscosity Index,[4] commonly referred to as V.I., was devised to indicate the relationship between oils with given changes in temperature.

A high V.I. oil indicates the least viscosity change with temperature variations. The viscosity change of a Pennsylvania oil is comparatively small for a given temperature change, while that of a Coastal or Naphthenic

[3]EDITOR'S NOTE: The American Petroleum Institute has two standard oils for calibrating viscosimeters; Alpha 40, 269 s.s.u. at 100 deg. F. and 210 s.s.u. at 210 deg. F.; and Beta 40, 1828 s.s.u. at 100 deg. F. and 115.4 s.s.u. at 210 deg. F. They may be obtained from Dr. T. G. Delbridge, The Atlantic Refining Co., 3144 Passyunk Ave. Philadelphia, Pa., for $5.00 per qt. sample. The National Bureau of Standards, Washington, D. C., is also in a position to supply oil samples calibrated at various temperatures from 20 to 100 deg. C. Details of cost and viscosity should be obtained direct from the Bureau.

[4]A full page chart designed, by E. M. Sims, for determining the Viscosity Index of Lubricating Oils appeared on page 88 of the May, 1940, issue of Power Plant Engineering.

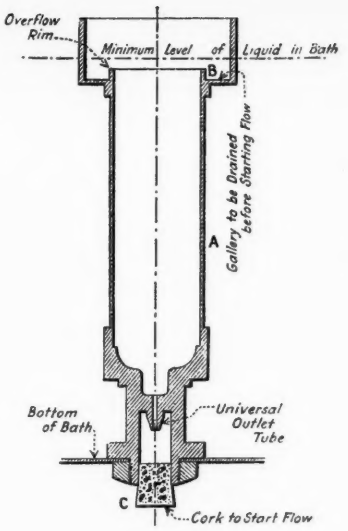


Fig. 5. Sectional view of the standard oil tube of the Saybolt viscosimeter in which the viscosity is measured in seconds required for the 60 cc. tube to empty. The Universal viscosimeter is used for oils of from 32 up to about 1000 sec. Above this the Furol viscosimeter with an orifice twice the diameter is usually more satisfactory. The outlet time with the Furol (contracted from "Fuel and Road Oils") is approximately 0.1 that of the Universal

oil is relatively large. Therefore, it was arbitrarily assumed that the V.I. of an average Pennsylvania oil would be 100, while that of the average Coastal oil would be assumed to be 0. Immediate base oils would, of course, fall between the range of 0 to 100. Charts are available from which, if we know the viscosity of any oil at 100 and 210 deg. F., the Viscosity Index can be determined.

Logically, an oil of high V.I. will not become excessively thin when subjected to high temperatures, nor excessively thick when cooled. For many services such an oil is highly desirable, but not always necessary. Service requirements alone can determine the V.I. need. The Viscosity Index has a twofold value to the consumer in that it indicates the viscosity change with temperature and offers information relative to the probable type of crude from which the oil was processed.

Viscosity is an important item to the operating engineer for it enables him to better select products to fit a particular requirement. The higher the viscosity the greater will be the internal friction or resistance to shear between the oil molecules, with the result that increased power will be required. Observation and study of temperatures and mechanical operations should be made with a view to reducing oil viscosity to a practical minimum. However, viscosity reduction must not be carried to an extreme degree where rupture of the oil film, with subsequent metal to metal contact, might be incurred. Such a condition would lead to metallic friction, excessive wear, and ultimate failure. For services where the oil is exposed to wide temperature variations an oil of high V.I. characteristics is indicated. Commercial oils, especially refined and containing V.I. improvers, are now obtainable having a V.I. as high as 150.

Simple Test

A simple, practical test for determining the viscosity of an unknown sample of oil with that of a known or standard sample can be performed by the use of two water-glass gages. Both ends are fitted with corks, wooden plugs, etc., the gages filled with the two samples of oil to within one inch of the top and sealed. The two gages are inverted at exactly the same moment and the rapidity at which the air bubble reaches the opposite end observed. If both bubbles reach the top at the same time, their viscosities are practically equal. This is only a rough, comparative method and not to be used wherever laboratory facilities are available.

Water and Sediment

Determination of water and sediment is of great importance because the presence of either is definitely objectionable. They are seldom contained in materials as received from the refiner, but carelessness in storage or handling often result in the introduction of either or both. The three laboratory methods most frequently employed in the detection of water and sediment are: (1) centrifugal method for both water and sediment; (2) distillation method for water; and (3) the extraction method for sediment.

Determinations by the centrifugal method (A.S.T.M. D96-35)[1], usually referred to as "B.S. and W.", is most frequently utilized due to reproducible results and convenience of performance. Standard centrifuge tubes are used into which is placed 50 c.c. of the sample and 50 c.c. of 90 per cent benzole. The tubes are heated to 100 deg. F. and are shaken until all soluble material is in solution. The tubes are then placed in a centrifuge capable of rotating the tubes at a speed of

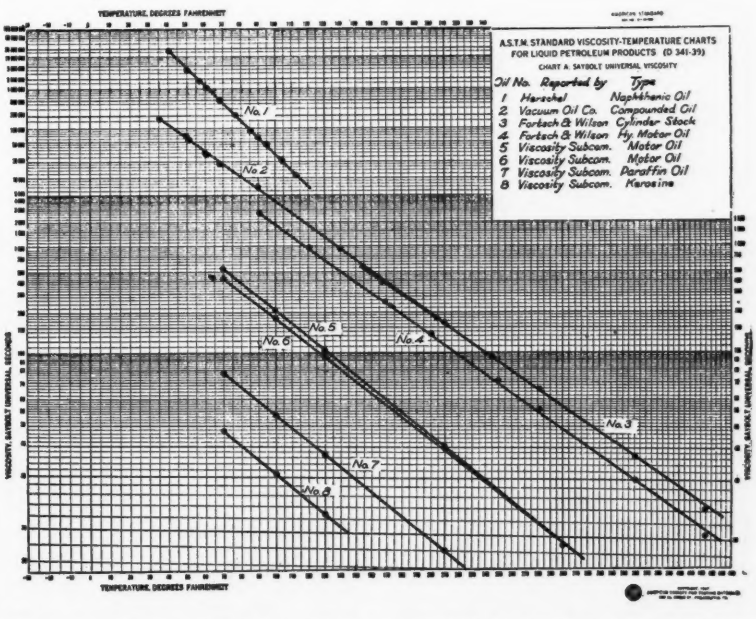
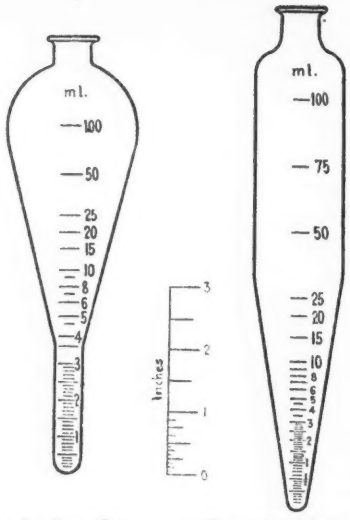

TEMPERATURE, DEGREES FAHRENHEIT
A.S.T.M. STANDARD VISCOSITY-TEMPERATURE CHARTS FOR LIQUID PETROLEUM PRODUCTS (D 341-39)
CHART A. SAYBOLT UNIVERSAL VISCOSITY
Oil No. Reported by Type
1 Harchel Naphthenic Oil
2 Vacuum Oil Co. Compounded Oil
3 Fortsch & Wilson Cylinder Stock
4 Fortsch & Wilson Hy. Motor Oil
5 Viscosity Subcom. Motor Oil
6 Viscosity Subcom. Motor Oil
7 Viscosity Subcom. Paraffin Oil
8 Viscosity Subcom. Kerosine
No. 1
No. 2
No. 5
No. 6
No. 4
No. 3
No. 7
No. 8
VISCOSITY, SAYBOLT UNIVERSAL, SECONDS
VISCOSITY, SAYBOLT UNIVERSAL, SECONDS
TEMPERATURE, DEGREES FAHRENHEIT

Fig. 6. Reproduction of Chart A from A. S. T. M. D341-39 showing the variation of viscosity with temperature for several typical oils. The curve for any given oil is a straight line which can be determined from two points, but the slope of the curve varies with the oil. A low viscosity index indicates a steep curve, as No. 1, where the viscosity changes rapidly with temperature. A higher V.I. indicates a flatter curve with less change of viscosity for a given temperature ranges as on No. 2



(a) Pear-Shaped Tube. (b) Cone-Shaped Tube.

Fig. 7. Tubes suitable for use in centrifuges for determining water and sediment according to A. S. T. M. D96-35. Another method of determining water content alone by distillation and condensation is covered by A. S. T. M. D95-30

approximately 1,500 r.p.m. for 10 min. This procedure is repeated until the volume of water and sediment is constant. The tubes are so graduated that readings are obtained directly.

Presence of water is especially hazardous in oils used in the power plant. Its presence in steam turbines aids in the formation of corrosion, iron oxide production, and resultant oil emulsification. When present in oils utilized in wick-feed lubrication, it produces a wetting action on the wick material and retards capillary action. This may result in starved lubrication. Its most serious offense, however, is when present in internal-combustion engine crankcases. Sulphur present in the fuel is burned to sulphur dioxide, and exhaust gases escaping into the crankcase are readily absorbed by any water present. The sulphurous acid formed is further oxidized to sulphuric acid. The result of this acid on highly finished metallic surfaces requires no comment.

Water is easily identified when present in oils, since it gives the oil a cloudy or hazy appearance. Dark or black oil, especially cylinder stocks, masks this effect. The following is a highly sensitive test for the determination of moisture and one which can be executed in a few minutes. The only materials required is an 8 oz. or half pint bottle in which is contained the sample of oil to be tested, and a ¼ in. steel rod. The steel rod is heated to a red heat and slowly lowered into the oil. If water is present, the tiny particles of water are suddenly converted into steam and a crackling noise is produced. If no water is present, only a slight hissing noise is emitted due to the formation of oil vapors.

Sediment, by nature, is highly undesirable since it is usually associated with sand, iron dust, abrasive dirt, etc. Due to its abrasive characteristics, it causes excessive wear to bearings, machined surfaces and it aids in the formation of gummy, resinous materials, which clog oil holes and allied channels.

EDITOR'S NOTE: A subsequent article "The Significance of an Oil Analysis" will discuss carbon residue, cloud and pour points, demulsibility and emulsion, neutralization number, evaporation tests and sulphur content. A third article, "The Significance of a Grease Analysis," will discuss the type, composition and application different greases and their properties including color and odor, texture, consistency, dropping point, channel tests and chemical analysis. Closely related to those are several articles by Vernon M. Huff, incorporating the practical plant experience of the author as staff engineer is the technical department of a large oil company. He divides the general subject of lubricating into three divisions, bearings, cylinders and gears. The two series of articles are complimentary. Mr. Rose interprets the practical significance of chemical and physical properties as determined by the laboratory. Mr. Rose carries this a step farther and tells how this information can be applied to the solution of the proper lubricant for specific service conditions. Both authors cast aside the veil of theory which surrounds the subject and get down to practical application, in which arbitrary hit and miss methods are superseded by sound technical experience and background.

Power Factor Improvement Pays 86 Percent Return

By W. L. KING
Chief Engineer, Hempstead Village Water Works
Hempstead, Long Island, N. Y.

THE MATERIAL published on power-factor improvement through the use of capacitors has for the most part stressed the advantages gained by power companies and large consumers. There has been relatively little covering the experience of the smaller consumer and for this reason it is felt that our experience may be of more than passing interest.

The Hempstead Village Water Works, Hempstead, L. I., N. Y., is owned and operated by the village. Water is drawn from six wells, each with its individual pump, and fed into a 2½ million gallon aeration basin. From here it is pumped into the mains system as required through a relift station. An elevated equalizer tank of one-half million gallon capacity is floated on the mains, with pressure maintained constant within the range of 68-72 lb.

The entire plant is located on a 15-acre tract within the village. There are six well houses spotted around this area, and in another main building are located the relift pumps. The latter and Wells No. 1, No. 2 and No. 3 are driven from the power lines of the local power company. The other three wells are Diesel powered and for that reason are not further considered in this description.

Prior to November, 1939, power was drawn through two sets of 4000-v. 3-phase, 4-wire feeders, as shown in Fig. 2. One entered the relift station with its four motors of 100, 150, 200 and 250 hp. and extended to Well No. 1, which has 40 hp. equipment. The second feeder entered at Well No. 2, where the step-down transformers were located for supplying both No. 2 and No. 3 Wells with combined equipment totaling 125 hp. Each of the two feeder systems was individually metered and billed. Each established its own demand rate. The power contract carries a power factor clause under which discounts are allowed as follows:

PF 81% — 83%	1% discount
PF 83% — 85%	2% discount
PF 85% — 87%	3% discount
PF 87% — 89%	4% discount
PF Over 89%	5% discount

The system comprising the relift station and Well No. 1 had taken advantage of the 3 per cent discount, with a power factor of 85-87 per cent maintained during the lighter load period of the six month winter season. In summer,

when the heavier load required the use of the larger equipment of the relift station, the power factor was increased to the 87-89 per cent range, earning 4 per cent.

The system of Wells No. 2 and No. 3, with power factor of 80 per cent, had not qualified for any discount.

In the fall of 1939, it was decided that economy dictated the consolidation of the relift station and these three wells on one feeder, as shown in Fig. 3. In this way, the demand rate for the second feeder would be eliminated and that of the other would not be increased. Moreover, billings on this latter feeder had always reached down into the 1-cent range while a good part of the billing for Wells No. 2 and No. 3 had been at 3 ct. Under the consolidation, the load added to the single feeder by these two wells would qualify for a straight 1-ct. billing.

Disadvantages

The one drawback to this arrangement was that the overall power factor of the combined systems would be such as to pull down the discounts formerly earned by Relift and Well No. 1 and this in turn would partially offset the savings resulting from the consolidation. It was this fact that focused attention on power-factor improvement possibilities which had previously been given little thought.

After due consideration it was determined that improvement by means of capacitators would be the most economical and practical from every standpoint. First cost would be relatively low, maintenance would be nil. Moreover, if connected directly across the feeders power-factor improvement would be gained throughout the entire system.

A little planning indicated that a 20 kv-a. capacitor unit would not only remedy the low power factor of Wells No. 2 and No. 3, bringing them into the "over 89 per cent" discount range, but would further improve conditions at Relift and No. 1 so that they too would henceforth qualify at all times for 5 per cent discount instead of the previous 3—4 per cent.

Installation

In November, 1939, the consolidation was effected. At the same time a single 20 kv-a. Cornell-Dubilier capacitor unit was installed. This was placed right at the primary side of the transformer bank which supplied the portion of the system having the poorest power factor . . . Wells No. 2 and No. 3.

The revised system went into full operation in November, 1939, and the "proof of the pudding" so far as its economic advantages are concerned, is found in the billing for January, 1940, as compared with the combined billings for the same month of the previous year. Such comparison was possible because all equipment was identical and the somewhat increased load of 1940 was not sufficient to carry the energy billings below the accustomed 1-ct. rate. The figures are:

Jan., 1939	48,862 KWH	$716.60
Jan., 1940	50,598 KWH	664.68
	Up 1,736 KWH	Down $ 51.92

Had the load remained the same in 1940 as in 1939, the 1940 cost would have been $647.32, representing a net saving of $69.28 or 9.66 per cent.

This saving includes (1) elimination of the previous separate demand rate for Wells No. 2 and No. 3, (2) a straight 1-ct. energy rate for energy consumed by Wells No. 2 and No. 3 instead of the previous higher scale, and (3) the increased discount obtained through power-factor improvement.

A detailed breakdown of points (1) and (2) is not important for consideration here but the power-factor improvement savings are pertinent.

The entire system qualified for the maximum discount of 5 per cent whereas the previous January, the Relift feeder had earned 3 per cent and the Wells No. 2 and No. 3 feeder nothing at all. The net saving due to PF correction during this month amounts to $14.74. Perhaps at first glance this amount does not seem tremendously impressive. To realize its full significance, however, it should be considered in the light of the investment involved.

The complete corrective capacitor unit, installed, cost $206. Its demonstrated earning of $14.74 (and calculations show that this figure will be approximately maintained as a monthly average throughout the year) represent an annual return of 86 per cent on this investment. In about 14 mo. the capacitor will have paid for itself and thereafter this 86 per cent is pure velvet.

It is interesting to note that without the consolidation, power factor improvement would have resulted in an even greater savings although two capacitors would have been required at a somewhat higher investment cost. We could, in the five years of the existence of this plant, have paid

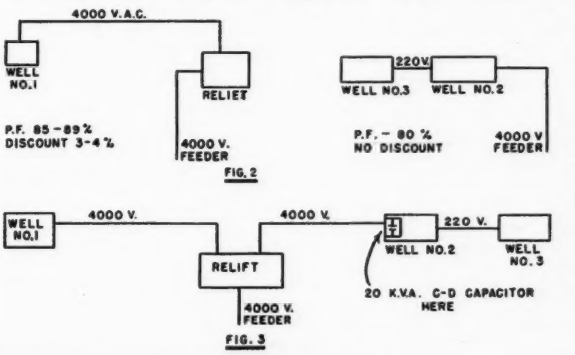


Fig. 2. A rangement before changes were made

Fig. 3. Present arrangement with capacitor installed at Well No. 2. With this arrangement, the power factor of the entire system was improved to exceed 90 per cent at all times and now earns a discount of 5 per cent

Fig. 1. Hempstead Water Works

for the capacitors out of savings and shown a net profit in the neighborhood of $700.

It is hoped that the experience described here may point the way to similar savings on the part of other relatively small consumers who, like ourselves, have considered the benefits of power-factor improvement limited largely to large consumers of power, or to utilities and others who have problems of inadequate feeder or equipment capacity which can be made adequate through reduction of the reactive load.

Diesel Ice Plant Data

COST OF MANUFACTURING artificial ice with power from Diesel engines has been discussed many times with claims and counterclaims both for and against this type of plant. Because of the ever-increasing interest in Diesel engines for ice making it is the purpose of this article to describe a typical Diesel-powered plant of average size that has been in operation sufficiently long to provide representative operating figures on fuel and lubricating oil costs, maintenance and repairs and ice production records from which actual expenses can be determined.

The W. B. Chaffee Artificial Ice Plant at East Providence, R. I., fulfills the above requisites. This plant has a rated capacity of approximately 80 t. per day with refrigerated storage facilities for 1500 t. It has been operating on Diesel-generated power since 1934, and accurate figures are available on power costs as well as ice production.

The Chaffee plant consists of two 10 by 10 in. York ammonia compressors rated at 40 t. each for ice making (65 t. each for refrigeration) each directly connected through a flexible coupling to a 6 cyl., 180 hp., 300 r.p.m. Atlas Imperial Diesel engine. Between each engine and compressor is mounted an a.c. generator. The generator capacity of one unit is 50 and the other 75 kw. These provide electric current for lighting and for the motor-driven equipment.

In addition, there is a 6 by 6 in. motor-driven compressor for precooling well water from approximately 50 to 36 deg. F. before filling the freezing cans. A similar 4 by 4 in. motor-driven compressor maintains a temperature of 28 deg. F. in the large storage room. The day storage room is maintained at 22 deg. F. by refrigeration from the two main compressors.

Motor-driven pumps supply all water required from two wells on the property, one 425 and the other 600 feet deep. The usual hoists, circulating water pumps, air compressors and other auxiliary equipment common to a plant of this type are all powered by the Diesel-driven generators.

Both Atlas Diesels were installed and placed in active service in June 1934 and produced 10,801 t. of ice during the balance of that year. The first full year of operation, 1935, showed the following results. Ice manufactured totalled 16,708 t. with No. 1 engine operating 4780 and No. 2 engine operating 3956 hr. Fuel consumption for both was 73,505 gal. at 4½ ct. per gal., and 330 gal. of lubricating oil was used at a cost of 52 ct. per gal.

Total cost of fuel and lube oil to produce 16,708 t. of ice, was, therefore, $3,479.32 or 21.8 ct. per t.

At the beginning of 1937 Mr. Chaffee decided to expand his business to include fuel oil as well as artificial ice. Fuel consumption figures for the following years must be considered on that basis, since power from the engines was diverted from ice making to oil pumping in considerable volume.

Such a combination is not uncommon in this type of business and the figures should prove interesting even though it is not possible to separate fuel used for ice manufacture and that for oil pumping, except by pro-rating on the basis of 1935 when no oil was handled. Data shown by Table I.

Lubricating oil consumption remained approximately in proportion to that of 1935 except for one year when piston rings other than those recommended by the manufacturer were installed. The immediate increase in lube oil required was so great that the owner returned to the standard type at the next overhaul period, at which time it returned to normal.

Table I. Fuel consumption and plant production for 5 yr.

YEAR	FUEL GALS.	T. OF ICE	OIL PUMPED GALS.
1935	73,505	16,708	.....
1936	79,820	16,320	744,958
1937	82,124	19,230	905,157
1938	85,762	17,280	1,112,680
1939	87,540	17,680	1,755,134

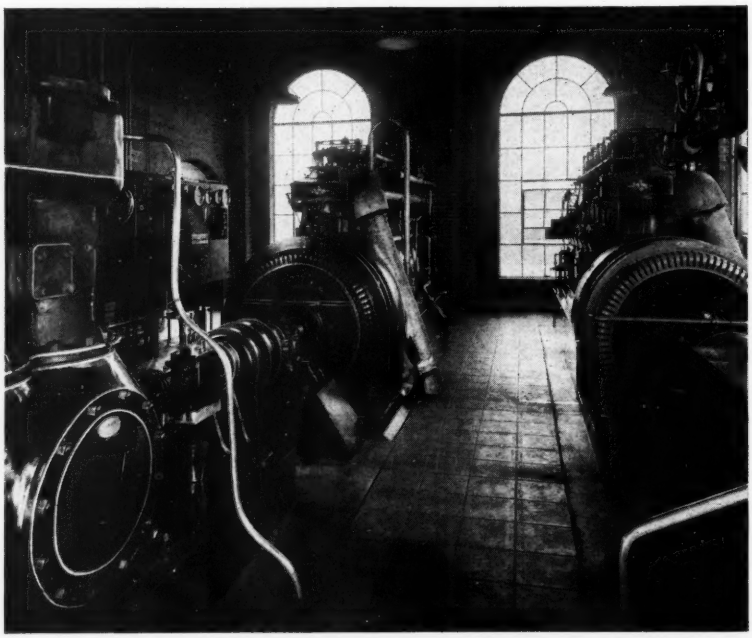


Fig. 1. The plant has two main units each consisting of a 10 by 10 in. York Compressor, an Electric Machinery A.C. generator and a 180 hp. Atlas Imperial Diesel

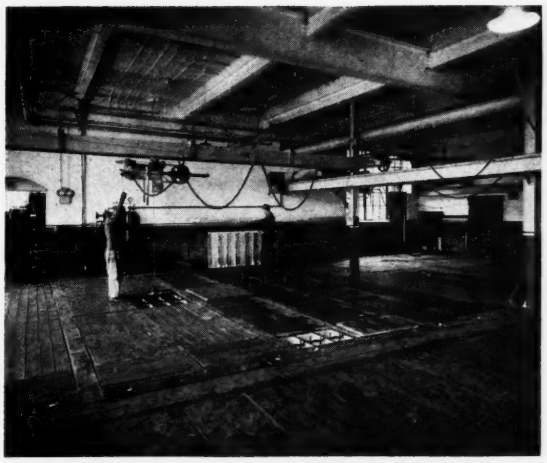


Fig. 2. The freezing tank tops. The engine room is through the arch at the left, the ice storage is behind the right wall

Fig. 3. In the summer—it's nice work if you can get it. During 1935 the fuel and lub. oil cost was 21.8 ct. per t.

When the Diesels were first placed in active service an arbitrary reserve for maintenance and repair was set up on the basis of 3 ct. per t. of ice produced or approximately $1.30 per hp. per yr. At the end of 1939, after 5½ yr. of constant operation, the actual cost of replacements as taken from invoices amounted to $925.88. This is only $0.47½ per hp. per yr., or approximately one-third of the established reserve, not counting the labor of the regularly employed personnel in the plant.

Chief Engineer Clarence Frey is pleased with the condition of the engines after this long period and reports remarkably slight cylinder wear. During this time the main bearings have not been touched. On the connecting rod bearings a shim or two has been removed. Each engine is shut down for complete overhaul once a year during the slack season because there is no time for anything but routine adjustment at other times, when both engines are running constantly.

Hydrogenation of Coal

DUE TO THE unequal distribution and the rapid rate at which petroleum reserves are being used, a great deal of work has been done throughout the world on the production of liquid fuel from coal and on the natural bitumens appearing in shales and sands. Gasoline has a hydrogen content of about 14 per cent whereas a bituminous coal will range only from 5 to 6 per cent so that any method intended to produce a large yield of gasoline from coal must be based on the addition of hydrogen.

Direct hydrogenation is intended to increase the hydrogen content chemically through the agency of high pressure. Indirect hydrogenation on the other hand is based upon the conversion of the coal to water gas after which hydrogen is added and the mixture catalytically converted to hydrocarbons and water. The former has been more extensively employed in Europe and is found to be more economical. It produces gasoline with a high knock rating and is applicable to other materials as well as coal and can be used to make benzine, toluene, phenol and other tar acids.

However, this process has not so far lent itself successfully to the production of first rate Diesel fuel or lubricating oil from coal and is not applicable to all coals.

Indirect hydrogenation on the other hand can be applied to any raw material from which water gas can be made; it provides a source of lubricating oil and also makes a good Diesel fuel. Aside from cost, its main disadvantage is that the gasoline fraction has a low knock rating.

Tests of direct hydrogenation made by the Canadian Department of Mines and Resources show considerable variation in the conversion into liquid oil and gaseous products of the coal. Yields of primary oil, for example, were between 44 and 77 per cent of the weight of the coal on the ash and moisture free basis.

37,000 Volts on Motor Belt

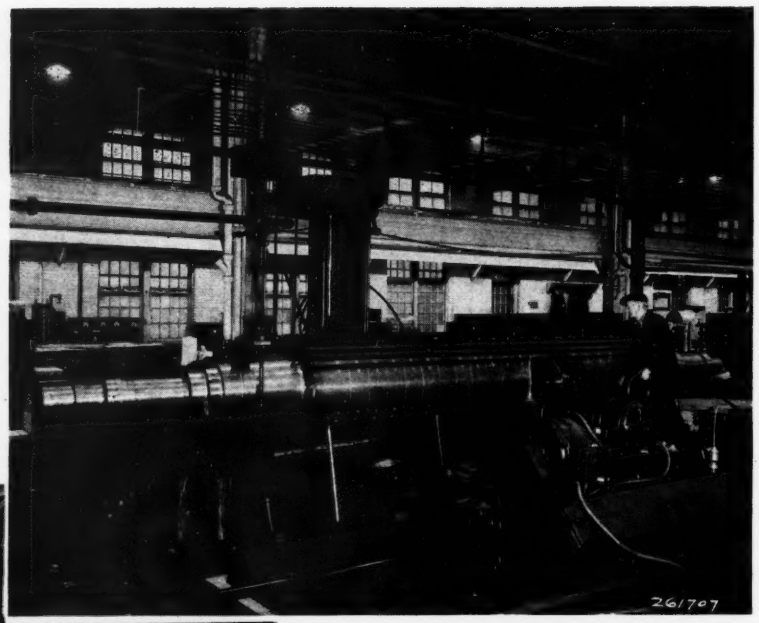
STATIC ELECTRICITY in a powder plant can be a very troublesome hazard, so a well-known chemical company recently conducted tests with a General Electric electrostatic voltmeter to find out the extent of the static electricity generated on their conveyor belts, motor drive belts, rubber tired trucks, and from actual walking on floors. In checking the V belt of a 25-hp. motor, the 20,000 v. static voltmeter went off scale—observation of the discharge spark indicated the presence of approximately 37,000 v. on the V belt. Another test indicated that 6000 v. were generated simply by walking across the carpet of an office.

These preliminary tests led to more extensive checks in all of the chemical company's plants. As a result, belt dressings were investigated to find one of a conducting nature that would permit a continuous discharge of accumulated static electricity. All trucks were equipped with grounding chains, various types of flooring were investigated, and many other changes were made to minimize the hazards of explosion from static electricity.

The G-E electrostatic voltmeter used in detecting the static is a 20,000-v. portable instrument designed for both a.c. and d.c. measurements of voltage on systems where one line is grounded. Operation is simply a matter of grounding the case, energizing the light source, and making the high-voltage connection.

Overcoming Double-Frequency Vibration in Generators

ROTOR and stator vibrations inherent in all two-pole turbine generators have been reduced 80 per cent by engineers of the Westinghouse Electric & Mfg. Co. A long, relatively slender two-pole rotor has a tendency to sag twice each revolution due to deep slots cut on two opposite sides for the field winding. Although small, the double-frequency vibration thus set up may have an adverse effect on the bearings and the collector rings and brushes.



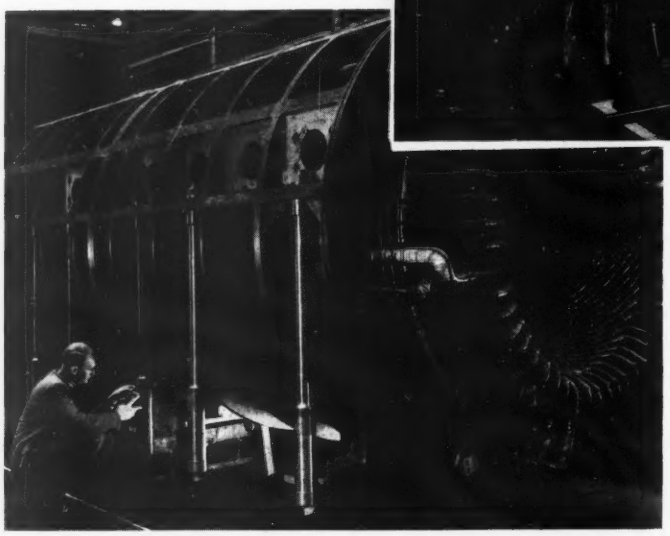


Fig. 1 (Above). Slotting the rotor. Workman at the East Pittsburgh plant of the Westinghouse Elec. & Mfg. Co. taking out the double-frequency vibration of a large two-pole, 3600 r.p.m. rotor by slotting it to provide equal rigidity on the two major axes

Fig. 2 (Left). Flexible supports for large two-pole generator. The amplitude of double-frequency vibration transmitted from stator core to foundation is reduced 80 per cent by means of flexible supports. Engineer above is examining a flexible support on a large two-pole 3600 r.p.m. turbine generator stator

Removing metal in the unslotted sectors of the rotor by cutting narrow slots at intervals effectively reduces its rigidity to compensate for the lengthwise slots but has relatively little effect on the magnetizing flux in the rotor body. This solution has reduced shaft movements of seven or eight thousandths to less than one thousandth inch.

Due to the tremendous pull of each pole, the stator takes a slightly elliptical shape, the ellipse revolving in step with the rotation of the two-pole field, and again creates an 120-cy. vibration. Unable to cure this ailment at the source, Westinghouse engineers devised an ingenious system of flexible mounting which prevents the passage of any vibration to the foundation.

Two sets of flexible supports, one of which permits the stator to "breathe" horizontally but not vertically, and the other tolerating vertical but not horizontal movements have reduced the vibration transmitted to the frame by 80 per cent.

New Wires and Cables Have Many Uses

SOME of the recently developed electrical conductors using new types of insulation have many uses. In the early years, about the only types of insulation available for use on conductors were rubber and asbestos. Today a wide variety of insulating materials are available, many of which are adapted to special conditions.

One of these new insulating materials goes by the name of Flamenol. Developed by the General Electric Co., Flamenol is a synthetic compound which resembles rubber but contains none. It is both an insulation and a finish for wire and cable. Enclosing the conductor of a cable, a single layer provides effective insulation as well as long time protection. It has high dielectric strength—superior to most rubber compounds, at the same time it is tough and strong, and needs no protective braid, lead or armor except where mechanical abuse is extremely severe.

Under normal operating conditions, Flamenol is practically ageless. It suffers no loss in properties when exposed to sunlight and oxygen, it is extremely stable when subjected to ozone and chemicals of an oxidizing nature, and it is not attacked by oils or solvents, or by acids or alkalies.

Furthermore, it is flame resisting; that is, it will not support combustion. It is highly resistant to moisture and because of its smooth finish dirt and other foreign substances do not readily adhere to it; the wire, at all times, presents a clean, bright surface and a neat appearance.

Why Turbines Have Changed—

By C. C. FRANCK
Westinghouse E. & M. Co.,
South Philadelphia, Pa.

WITH THE BEGINNING of the recent power station expansion program, a remarkable advance in operating conditions was undertaken for the advent of the superposition plant opened new and uncharted courses and a plan was launched which severely taxed the designer's resources. Up to this time steam turbines were operated with 750 deg. F. T. T. as the normal throttle temperature with rare cases of operation with 825 deg. F. T. T. The step from this known field to one of absolutely unknown character was made possible through the cooperation and assurance of the metallurgists and designers that materials could be produced and designs so proportioned to reduce to a minimum the devastating effect of the higher temperatures.

It was felt at that time that carbon molybdenum steel offered the same design factor of safety at 925 to 950 deg. F. T. T., that ordinary carbon steel had already demonstrated at 825 deg. F. Consequently, with the satisfactory operating experience obtained on the 825 deg. F. units, the design was projected into the higher temperatures. The increase in inlet pressures from 400 and 650 to 1250 lb. per sq. in. ga. presented no particular problems, but when coupled with the higher temperatures formed tremendous problems in the design of turbines.

Thermal considerations, mainly those of differential expansion, presented the most difficult problems. For example, superposed turbines with 925 to 950 deg. F. at the throttle usually have an exhaust temperature of from 500 to 550 deg. F. and condensing turbines with the same initial temperature have from 80 to 100 deg. F. temperature at the exhaust.

When it is considered that units of this type must start from room temperature, ultimately come up to the normal operating temperature and finally come back to room temperature when the unit is shut down, there is no question as to the complex aspect of the design problems involved. The first major problem is one of differential axial expansion. Assume for example a turbine which is approximately 15 ft. in length with a temperature gradient of from 900 to 100 deg. F., or an average temperature of 500 deg. F. The calculated elongation above an 80 deg. F. room temperature is $0.0000075 \times (500\text{-}80) \times 15 \times 12 = 0.56$ in. This differential expansion must be accounted for in three phases of operation; namely, starting, running and shutting down.

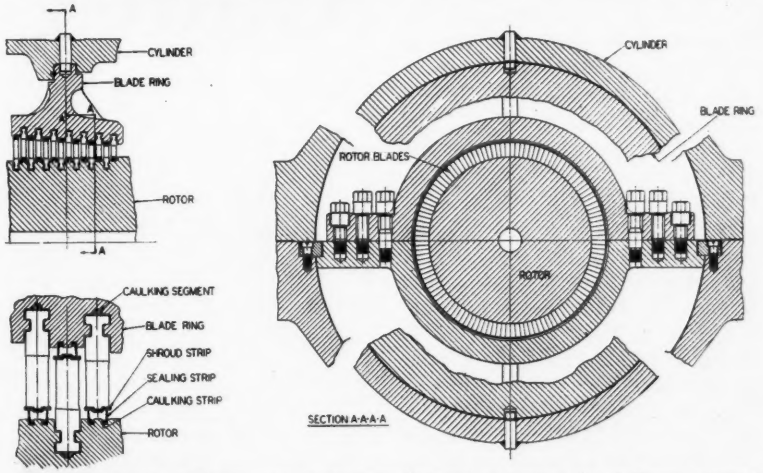


Fig. 1. Separate stationary ring construction designed to insulate the stationary elements from the outside casing and maintain them at approximately the same temperature as the rotating elements

Operating Cycle

Changes in elongation as the ordinary turbine goes through its normal phases of operation in three steps. First, the hot steam from the inlet envelops the rotor causing it to expand axially relative to the cylinder. Second, the casing expands with time, and the temperature of the rotating and and stationary elements in any section of the unit is approximately the same. Consequently the parts will ultimately have expanded uniformly and are capable of maintaining their original cold axial clearances. The third step, that is shutting down is different in nature between the superposed and condensing unit. When the steam is shut off the superposed turbine, the small light rotor will give off its heat at a more rapid rate than the cylinder, through the medium of conduction to the bearing oil and will consequently contract axially relative to the cylinder. In the case of the condensing machine where the rotor is approximately the same or greater mass than the cylinder, the rate of cooling is approximately the same and consequently very little if any differential motion is experienced.

The solution to the problem lies in the correct location of the fixed point of the rotor, with respect to the cylinder, from which the expansion starts and to allow the proper axial clearances between the stationary and rotating parts to take into account the differential axial expansion during the three phases of operation.

One end of the cylinder, preferably the exhaust or "cold end," is keyed to the foundation to prevent motion relative to space in an axial direction. The opposite end, the inlet or "hot end" is left free to move in an axial direction. Correct alignment in the transverse direction is maintained by keys placed in the vertical center plane. The rotating element is attached to the free end of the cylinder through the medium of the thrust bearing and follows the motion of the stationary element

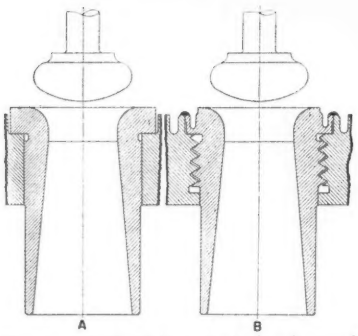


Fig. 2. At the left a typical valve and pressed-in diffuser seat and at the right changes made in the construction for high temperature services

with this as a fixed point. Consequently, it may be observed that the neighboring parts of the stationary and rotating elements maintain approximately the same axial relations under all conditions of temperature distribution, once the normal operating temperature has been established.

It is also to be noted that the large variations in axial position are associated for the greater part with the starting and stopping phase of operation. Taking advantage of this fact it is possible to make provisions for adjusting the relative position of the stationary and rotating parts by moving the free ends of the two parts relative to one another. This is accomplished by the addition of an adjustable thrust mechanism which makes possible the use of larger axial clearances during starting and stopping.

When considering the use of this type of mechanism it should be kept in mind that the temperature changes of well insulated bodies are relatively slow. Consequently the manipulation of the axial clearances does not require immediate attention. This factor is of considerable advantage since shut down conditions may sometimes be caused by emergencies which in themselves require practically the full time and consideration of the operators during the shut down period. This adjustable feature is very important in the case of the superposed unit with a relatively light rotor and the necessity of close axial running clearances.

The second major problem is that of differential radial expansion. It is obvious that during the starting phases of operation, the rotating element may grow radially faster than the stationary element and if the differential movement is sufficient may result in a rub. Also in shutting down, the stationary element may radiate heat at a more rapid rate than the rotating element and exert a clamping action on the rotating element resulting in a rub. The solution of this problem lies in the proper provision for the stationary element to remain at the same temperature as the rotating element at the time when rapid changes in temperature are taking place. This may be accomplished by the use of separate ring construction for the stationary elements.

Figure 1 shows the separate stationary ring construction. It may be observed that the circulation of steam over and around the ring insulates it from the outside cylinder and maintains the stationary ring at a temperature approximately that of the rotating element. The separate rings are mounted by point contact at the horizontal joint and held in correct alignment by clearance pins at the top and bottom of the cylinder, thus exerting no expansion forces whatsoever on the outer casing. The rings are aligned in the horizontal and axial planes through the center of the machine and maintain that alignment regardless of the change in the shape of the outer casing. The stationary rings are provided with interstate sealing rings and the differential pressure across the ring maintains the seal.

Admission Valves and Blading

Differential temperature effect is also manifested in admission valve parts such as the diffusers in the steam chest. Figure 2A shows a typical valve and diffuser type seat. It may be seen that due to the flow of hot steam through the diffuser seat, in starting, the diffuser expands at a faster rate than the body of the steam chest. Consequently any press fit at this point would be destroyed and the dynamic force of the flowing jet would tend to lift out the valve seat.

Figure 2B illustrates the solution of this problem and shows the type of valve seat used for high temperature application. It is to be observed that the screw fit is loose enough to accommodate the radial expansion of the valve seat and yet provide for holding it in place. A flexible upper lip is provided on both the valve seat and the steam chest body for the purpose of applying a seal weld. The surface at the bottom of the seat is provided to take the side thrust resulting from the steam flow.

Operation with higher pressures and temperatures has resulted in increased demands on the blading and the most severe effects have been experienced in the first stages of the superposed type of turbine. When it is considered that a superposed unit of 50,000 kw. capacity is in reality equivalent to the high pressure element of a 125,000 kw. complete expansion turbine generator unit, it is not difficult to recognize the gigantic task which the superposed unit is called upon to perform.

Also when the mode of operation of the superposed unit is considered it becomes evident that the design must be extremely versatile. The unit usually operates with a fixed inlet and exhaust pressure regardless of the load and it must be capable of performing efficiently at light loads as well as at rated load. This condition

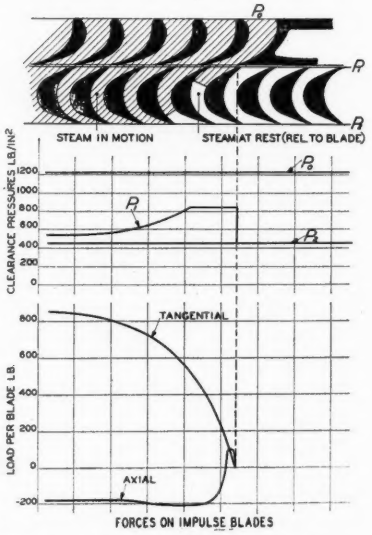


Fig. 3. Theoretical analysis of conditions existing in impulse blading which must be made extremely rugged to take care of the torque and axial forces

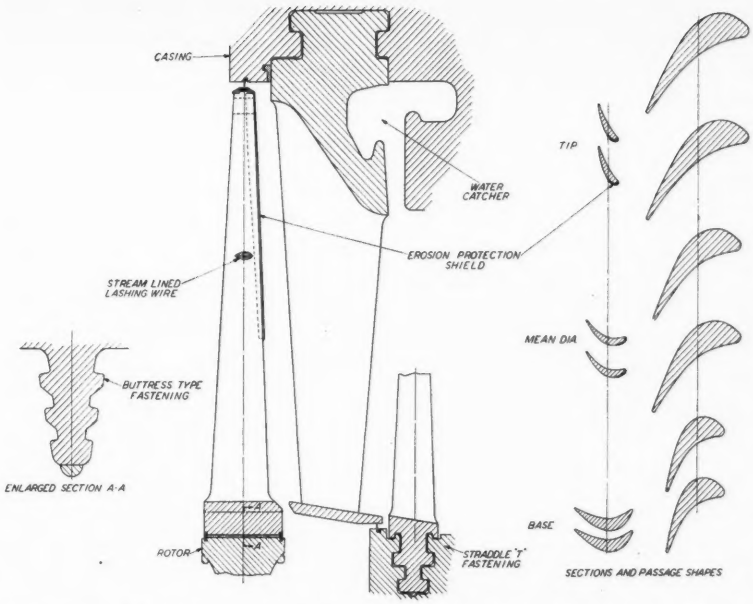


Fig. 4. Shrouded low pressure reaction blading showing the blade sections at different points, sealing strips and water catchers

is important from an economy standpoint, but is even more important from an operating consideration when it is considered that the exhaust temperature is a direct function of the internal efficiency of the machine.

This naturally demands the use of a variable admission first stage element to eliminate the effect of throttling with reduction in load and flow. The choice of a suitable element for this condition falls naturally to the impulse type which is most suitable for taking the variable energy drops encountered over the range of operation.

A normal superposed unit with 1250 lb. per sq. in. ga. at the throttle is designed at full load to have a pressure of approximately 900 lb. per sq. in. after the first or variable admission stage and the remainder of the drop across the succeeding or fixed admission stages. Following through this design at one fourth load it is recognized that the variable admission feature of the first stage establishes throttle pressure of 1250 lb. ahead of the stage, while the pressure after the first stage will naturally drop to approximately 375 lb. so the pressure drop across the first stage element is more than doubled and practically the whole load is being carried by the first stage. Finally due to the reduction in the arc of admission with flow, the load is distributed over a relatively small number of blades.

The variable admission impulse type element may be either of the single rotating row type commonly called the Rateau Element or of the double rotating row type commonly called the Curtis Element. The principle of operation of the two types of impulse elements is identical in that theoretically the complete pressure drop is taken across the stationary part of the element known as the nozzle. In the case of the Rateau Element the kinetic energy of the jet is transformed into work in one stage, while in the Curtis Element the work is extracted in two stages.

Figure 3 shows a theoretical analysis of the conditions existing in both types of elements under operation at light load. The blade after passing through an inactive arc comes up in front of a live steam jet. The live steam flows into the blade and sets up a flow around the curved surface which results in a reaction towards the nozzle. The steam continues on its path and ultimately displaces the dead steam from the passage and exerts a force which has a net resultant reaction on the blade in a direction away from the nozzle.

At this time the blade begins to convert kinetic energy into work in the form of torque and the blade is loaded in the direction of rotation. Also due to the shape of the blade and the physical relation between the nozzle and the blade, the condition of continuity of flow is established with a definite pressure drop across the blade. Thus it is seen that the blade in entering the live steam jet is pulled toward the nozzle, pushed away from the nozzle, and finally is pushed in the direction of rotation and away from the nozzle after the steady state of flow has been established.

Water in Steam

On top of these conditions the temperature differentials encountered in starting and during operation, when possible water may come over with the steam, add thermal distortions setting up tremendous forces which must be taken into account in the design of the blading.

Blades used for this severe duty are extremely rugged to take the torque and axial forces. The double T root or fastening is used to transmit the centrifugal forces of the blade to the rotor. Due to the thermal distortions to which the first rotating row is subjected, these relatively short blades are designed to take the load. The height of the second rotating row is sufficient to offer flexibility to absorb thermal distortion, and a

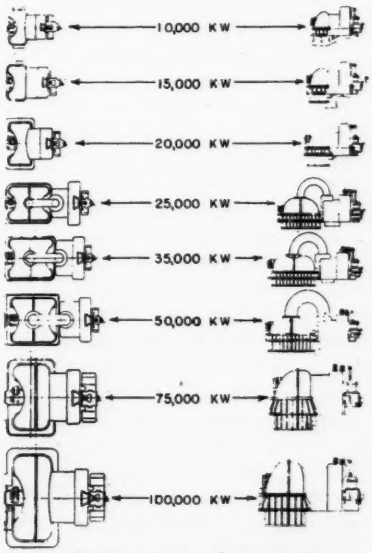


Fig. 5. Outlines showing the type and comparative size of a complete line of large turbines

considerable gain in strength and dampening properties may be realized by joining the blades in groups. This is done by the use of a dovetail strap, fitted into the shroud and welded securely to the individual blades.

Intermediate stages of neither the superposed and condensing type of turbines have presented any particular design problem. Two types of blading are used, one is of the straight radial sealing and the other with a combination of axial and radial sealing. The latter is a refinement used for establishing and maintaining close axial operating clearances with resultant reduction in leakage losses and high efficiency. All radial sealing is accomplished on flats and no sealing on tapers is used. This eliminates the possibilities of rubs due to axial differential expansion and permits a certain amount of axial displacement without difficulty.

Blades are bonded together in groups by shrouding which is fitted over pegs at the ends of the blades and welded securely into place. Radial rubs may take place with a minimum of heat generated in the thin radial seals and this seat is readily radiated to the surrounding steam and carried away. The seal strips are rolled in circular shape to conform to the groove and are held in place securely by rolled and caulking packing pieces.

Low Pressure Blading

Conditions surrounding the low pressure blading have become more critical with the advent of higher inlet pressures and increased turbine efficiencies, resulting in higher moisture content in the low pressure zone. With steam conditions of 350 lb., 750 deg. F., 29 in. vacuum, the moisture content in the exhaust is approximately 12 per cent; it is 13 per cent with 650 lb., 825 deg. F., 29 in. vacuum; and with 1250 lb., 900 deg. F. T. T., 29 in. vacuum, is 15 per cent. This increase in the moisture content, not a minor item in itself, has been paralleled by an increase in the speed of the blading in attempting larger exhaust annulii to increase rating or to reduce leaving losses. Blade tip speeds have risen from 900 or 1000 to a maximum of 1250 ft. per sec.

The solution to this problem seems to have been found in the nature of three mechanical and one thermodynamic considerations. First it was recognized that improving the flow conditions through the blading would give a more uniform distribution of the water droplets over the full length of the blade and eliminate water concentration at the outer periphery in the region of high tip speed. This was accomplished by the use of a "constant circulation" blade which makes possible smooth axial flow and eliminates the inefficient conical flow along a taper.

Figure 4 shows the general arrangement of this type of low pressure blading, both for rotating and stationary elements. Water catchers have been found to be quite effective in removing the free moisture from the steam. The figure shows the general construction of the water catchers as applied to the low pressure section of a condensing turbine. The water thrown off by the centrifugal action of the steam flow and the rotating blades is caught in the outer cavities and drained off into the condenser.

When the length of the blade demands lashing wire in addition to the shrouds, the lashing wire is made in a "tear-drop" or streamlined section to effectively break up the water concentration immediately following the lashing wire and eliminate excessive cutting of the outlet edge of the blade.

Finally the rotating blading is protected by shields hooked around the inlet edges and silver soldered to the blade section. Stellite has been found to be the most suitable and effective material for erosion protection and stellite shields have been used successfully for a number of years. Operating experience with the new type of blading has been extremely gratifying and the erosion in the high speed blade operating with high moisture content has been reduced to an unbelievable minimum.

Figure 5 shows a composite picture of a complete line of condensing turbine frames from 10,000 to 100,000 kw., giving a comparison of the overall size and shape of the different types of units. The first three frames are of the single cylinder type, designed for ratings of 10,000, 15,000, and 20,000 kw. at a speed of 3600 r.p.m. The next three frames are of the tandem type, designed for ratings of 25,000, 35,000 and 50,000 kw. at 3600 r.p.m. These frames develop out of the first three frames by arranging the low pressure blading for double flow operation. This type of machine is particularly adaptable to the trend towards higher steam inlet conditions since the high pressure and temperature is confined to the compact high pressure element. The next two frames are of the single cylinder type designed for ratings of 75,000 and 100,000 kw. at 1800 r.p.m.

Industrial Fire Hazards

FROM time to time industrial progress creates hazards which are difficult to control because of lack of experience. Some of the more recent industrial fire hazards were outlined by T. Alfred Fleming, Director of Conservation of the National Board of Fire Underwriters at the Fifth Annual Indiana Fire School held at Purdue University.

For many years it has been known that dust in flour mills and grain elevators is particularly hazardous. More recently it has been found that similar dangers lurk in practically all industrial dust except those from stone. Recently in a New York brewery a serious explosion took place when dust from unloading coal was exploded by a spark from an acetylene torch. Finely ground coffee also resulted in a serious explosion. In another plant while dust from refinishing flour caused a third explosion. This dust was thrown into an ordinary incinerator in an apartment house.

Static electricity is always a potential hazard whenever the belt moves or wheel turns. The voltage may run from 5000 to 65,000 v., sufficiently high to cause a spark which may ignite any dust or oil vapor which may be present. A common method of determining the presence of static electricity is to hold a cotton thread near moving machinery. If static electricity is present, the thread will bristle up. All shaft hangers, shafts and moving machinery should be grounded to a perma-

nent moisture ground or to a water supply system.

New and unknown chemicals form another hazard which is causing increased difficulty for fire departments. In one case, a substance was being used for removing soot from boiler flues. An explosion took place and an investigation disclosed that one of the ingredients of the solution was saltpetre. Saltpetre and carbon are the main ingredients of gun powder. The saltpetre in the solution mixed with the carbon of the boiler flues and stack combined to form the explosive mixture.

Metal Alloys

Aluminum and magnesium alloys may also give trouble because of their reaction to moisture. In a middle western machine shop the shavings took fire while one of these alloys was being machined. The fire department, not knowing the circumstances, used water upon the blaze, with the result that one man was killed and 11 seriously injured. The best method to extinguish an aluminum or magnesium fire is to use powdered pumice or stone dust.

It is of course obvious and perhaps unnecessary to call attention to the fact that many industrial hazards which have been known for years still exist. Among the most common of these is paint spray booths and storage of film.

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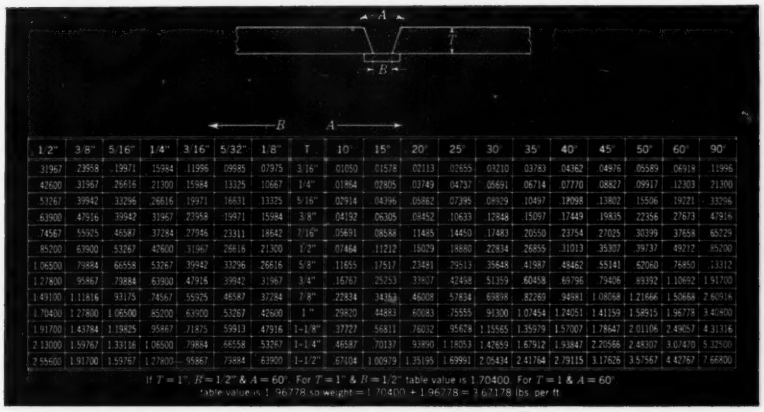
Table II. Weights of deposited weld metal in pounds per foot for butt welds



1/2"	3/8"	5/16"	1/4"	3/16"	5/32"	1/8"	T	10°	15°	20°	25°	30°	35°	40°	45°	50°	60°	90°
.31967	.23958	.19971	.15984	.11996	.09985	.07975	3/16"	.01050	.01578	.02113	.02655	.03210	.03783	.04362	.04976	.05589	.06918	.11996
.42600	.31967	.26616	.21300	.15984	.13325	.10667	1/4"	.01864	.02805	.03749	.04737	.05691	.06714	.07770	.08827	.09917	.12303	.21300
.53267	.39942	.33296	.26616	.19971	.16631	.13325	5/16"	.02914	.04396	.05862	.07395	.08929	.10497	.12098	.13802	.15506	.19221	.33296
.63900	.47916	.39942	.31967	.23958	.19971	.15984	3/8"	.04192	.06305	.08452	.10633	.12848	.15097	.17449	.19835	.22356	.27673	.47916
.74567	.55925	.46587	.37284	.27986	.23311	.18642	7/16"	.05691	.08588	.11485	.14450	.17483	.20550	.23754	.27025	.30399	.37658	.65229
.85200	.63900	.53267	.42600	.31967	.26616	.21300	1/2"	.07464	.11212	.15029	.18880	.22834	.26855	.31013	.35307	.39737	.49212	.85200
1.06500	.79884	.66558	.53267	.39942	.33296	.26616	5/8"	.11655	.17517	.23481	.29513	.35648	.41987	.48462	.55141	.62060	.76850	1.33312
1.27800	.95867	.79884	.63900	.47916	.39942	.31967	3/4"	.16767	.25253	.33907	.42498	.51359	.60458	.69796	.79406	.89392	1.10692	1.91700
1.49100	1.11816	.93175	.74567	.55925	.46587	.37284	7/8"	.22834	.34362	.46008	.57834	.69838	.82269	.94981	1.08068	1.21666	1.50668	2.60916
1.70400	1.27800	1.06500	.85200	.63900	.53267	.42600	1"	.29820	.44883	.60083	.75555	.91300	1.07454	1.24051	1.41159	1.58915	1.96778	3.40800
1.91700	1.43784	1.19825	.95867	.71875	.59913	.47916	1-1/8"	.37727	.56811	.76032	.95628	1.15565	1.35979	1.57007	1.78647	2.01106	2.49057	4.31316
2.13000	1.59767	1.33116	1.06500	.79884	.66558	.53267	1-1/4"	.46587	.70137	.93890	1.18053	1.42659	1.67912	1.93847	2.20566	2.48307	3.07470	5.32500
2.55600	1.91700	1.59767	1.27800	.95867	.79884	.63900	1-1/2"	.67104	1.00979	1.35195	1.69991	2.05434	2.41764	2.79115	3.17626	3.57567	4.42767	7.66800

If $T = 1"$, $B = 1/2"$ & $A = 60°$. For $T = 1"$ & $B = 1/2"$ table value is 1.70400. For $T = 1$ & $A = 60°$ table value is 1.96778 so weight = 1.70400 + 1.96778 = 3.67178 lbs. per ft.

Weld Costs Per Foot

By MERRIT L. SMITH
Metal & Thermit Corporation
New York, N. Y.

CLOSE ESTIMATE of the total cost per foot of welding, including labor cost, power cost and electrode cost, can be made by using the factors outlined below together with the formula and the information in Table I.

Where a highly accurate figure is required, it is recommended that all such factors as deposition rate, deposition efficiency, etc., be determined by actual measurement.

Where only a close approximation of costs is needed for estimating or other purposes, however, such information may be obtained from the electrode manufacturer.

Weights of weld metal required for standard butt welds with various included angles and root gaps in different thicknesses of plate are given in Table II.

Table I. Factors involved in determining weld costs considering the cost of electrodes, labor and power

Factor	*Symbol*	*Remarks*
Current Strength (Amperes)	A	Determine proper amperage for electrode and application involved and use this figure. Check machine ammeter where highly accurate results are required.
Arc Voltage (Volts)	V	Measure arc voltage at machine or consult electrode manufacturer for arc voltage of electrode at amperage being used.
Deposition Rate of Electrode (Lbs. per hr.)	R	Measure, or consult electrode manufacturer for deposition rate of electrode at amperage being used.
Deposition Efficiency of Electrode (%)	D	Measure, or obtain deposition efficiency of electrode, at amperage being used, from electrode manufacturer.
Length Efficiency of Electrode (%)	S	For close estimating, measure average stub losses in shop where work is to be done. For rough estimating, use rule of thumb: 15% for 14 in. electrodes. 11.7% for 18 in. Length efficiency equals 100% minus stub end loss in Per Cent.
Overall Efficiency of Electrode (%)	E	Overall efficiency of electrode equals deposition efficiency times length efficiency. (E = D x S)
Weight of Weld Metal Required (lbs. per ft.)	W	Consult Table A for this figure where a very accurate estimate is needed and design of weld conforms. Where other weld designs are involved, the pounds of weld metal required per foot of weld may be obtained from tables published regularly on Page 4.
Arc Time (%)	T	Measure average arc time in min. per hr. and divide by 60.
Electrode Cost (dollars per lb.)	C	Consult electrode manufacturer's price list.
Labor Cost (dollars per hr.)	L	Determine wage rate paid to welders in shop where work is to be done.
Power Cost (dollars per K.W. hr.)	P	Determine local power rate.

FORMULAE

$$\text{Electrode Cost per Foot of Welding} = \frac{C \times W}{E} \frac{\text{(dollars)}}{\text{(foot)}}$$

$$\text{Labor Cost per Foot of Welding} = \frac{L \times W}{R \times T} \frac{\text{(dollars)}}{\text{(foot)}}$$

$$\text{Power Cost per Foot of Welding} = \frac{P \times V \times A \times W}{1000 \times R \times T} \frac{\text{(dollars)}}{\text{(foot)}}$$

$$\text{Total Cost per Foot of Welding} = W \left(\frac{C}{E} + \frac{L}{R \times T} + \frac{P \times V \times A}{1000 \times RT} \right) \frac{\text{(dollars)}}{\text{(foot)}}$$

EXAMPLE

Determine costs per foot of weld for 60°, partially grooved, single-V, butt joint, with back-up strip and ½" gap, in one inch plate, using ¼" x 18" Murex Type F.

A = 450 T = 35% C = $.07
V = 37.7 R = 10.81 L = $1.09
E = 59.99% D = 67.95% P = $0.02
W = 2.67 S = 88.3%

$$\text{Electrode Cost per Foot of Weld} = \frac{.07 \times 3.67}{.5999} = \$0.428$$

$$\text{Labor Cost per Foot of Weld} = \frac{1.09 \times 3.67}{10.81 \times 0.35} = \$1.057$$

$$\text{Power Cost} = \frac{.02 \times 37.7 \times 450 \times 3.67}{1000 \times 10.81 \times 0.35} = \$0.329$$

$$\text{Total Cost} = 2.67 \left(\frac{.07}{.599} + \frac{1.09}{10.81 \times 0.35} + \frac{0.02 \times 37.7 \times 450}{1000 \times (10.81 \times 0.35)} \right) = \$1.813$$

NOTE: *In working out this example, all values are assumed except W, which is obtained from Table A.*

Don't Guess—Be Sure

Simple and economical boiler test arrangement well adapted for the small and medium sized plant

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Engineman in charge
Milwaukee County House of Correction
Milwaukee, Wis.

EQUIPMENT TESTS, especially evaporation tests on boilers, are often dreaded by the power plant force, because of the preparation necessary. This need not be such a disagreeable task if advantage is taken of a little simple equipment simply installed. The wealth of information and data obtained, if properly used, will pay dividends equal to many times the cost of the test setup, and the employees will welcome the test as a pleasant break in the every day routine.

It is a small matter with the apparatus described below to run a test before and after any changes in operation, alteration of boiler settings, etc. The results of these tests should be recorded so that comparisons can be made and the greatest benefits derived from the information gained.

Data sheets Nos. 1 and 2 of Fig. 2 are for the tabulation of readings recorded during the test period and from which the boiler test reports are calculated. These forms were developed to meet the needs of the Milwaukee County House of Correction power plant and may be modified to meet conditions elsewhere. They have proven very satisfactory.

The Small Plant

Any small or average sized power plant can easily arrange the apparatus need in such a way that a test can be started in a few minutes at any time. The apparatus necessary is: a set of scales for the weighing of fuel; two measuring tanks; one boiler feed pump if the feed water heater has sufficient elevation to fill the tanks by gravity (in the case of a heater without sufficient elevation, two pumps are required, one to pump to the measuring tanks, one to pump from there to the boiler). Figure 1 shows the arrangement where two feed pumps are necessary, and is adaptable to a greater number of plants. One man is required for the tabulation of data and operation of the apparatus. Where the heater has sufficient head, pump No. 2 may be eliminated by running the test suction pipe 23 direct to the lever operated valves 14 and 15 for filling the tanks.

During normal operation suction line 24 is in use and either pump may be used for boiler feed purposes. During a test, pump No. 1 is used to feed the boiler.

To start a test, first open valves 4 and 11A, close valves 11B and 10 and open valve 11. Start pump No. 2 and fill the tanks through the lever valves 14 and 15. These two valves may both be closed at the same time and the water will circulate through the relief valve 16 and the pump.

Open valve 9 and connect operating lever 21 so that water flows through the suction line 24 to pump No. 1 from one of the tanks. Do not count this tank of water for the records. Now close valve 3 in suction line 24 so that pump No. 1 receives all its water from the tank that is emptying.

Keep feeding the boiler in this way until ready to start the test. Then reverse the position of operating lever 21 so as to start using water from the full tank. Begin recording data with this tank. Any time the position of the operating lever 21 is reversed, the flow of water will stop from the tank that was emptying and start from the other tank. Record the temperature of each tank of water separately.

Hook gage 18 is a piece of No. 20 gage sheet metal bent into the shape shown and hung on the overflow. The lower end is formed so that it has approximately 1½ in. in a horizontal position and then about 1 in. bent up at an angle (points a and b on the sketch). When the tank is emptying and point, a, breaks the surface of the water, the operator gets ready when he sees point, b, break the surface of the water he reverses the position of the operating lever 21.

The Last Tank

This simultaneously stops the flow from the tank being emptied and starts flow from the full tank through the action of the lever operated valves 12 and 13. This enables him to use the same amount of water from each tank each time, as they are all filled to the overflow and emptied to the same point each time. The

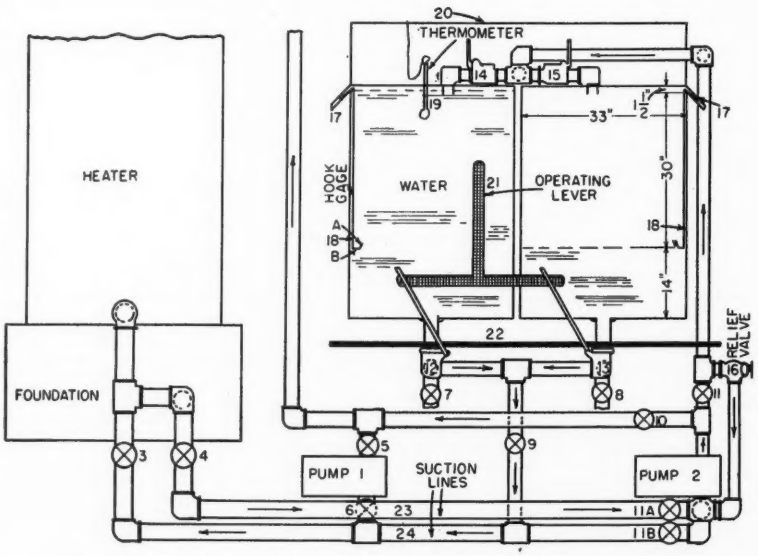


Fig. 1. Layout of a simple measuring tank arrangement for small boiler tests.

last tank used may be a fraction of a tank which can be easily measured with a rule and the fractional volume calculated. Valves 7 and 8 are for draining and cleaning purposes.

With this equipment care should be exercised not to extend the gages too deep into the tanks. In operation a whirlpool will form around the outlet when the water is low and will be drawn down into the whirl and displace water that gives a false reading. Also if the tanks are entirely emptied trouble will be experienced from air entering the feed pump.

Size of the tanks must be determined from the amount of water used by the boilers. The tanks in the sketch are 44 in. to the overflow and 33 in. in diam. The amount of water used from each tank is 14.81 cu. ft. and they are of ample capacity to handle water for tests up to 700 b.hp.

With a record of tests made before and after changes of any nature affecting the economy of the power plant are made, the engineer is in a position to know just what were the changes accomplished. On matters of this kind we should not guess, we should be sure.

P. G. & E. Solves Industrial Problem

P. G. & E. building three 1400 lb., 925 deg. F. plants adjacent to oil refineries in the Martinez District at a cost of $5,000,000 each. By-product fuels will be used, with process steam and electric power supplied to the refineries, and excess power capacity available to the company's interconnected system. Condensing-extraction turbines and forced draft cooling towers make output independent of industrial requirements

WHILE power plant capacity is being added at an unprecedented rate in all sections of the country, three of the most important of the newer plants are being built by the Pacific Gas & Electric Co. adjacent to three oil refineries in the Martinez (Cal.) district on the east shore of San Francisco Bay. One at the Tidewater-Associated Refinery, Avon, Cal., will soon be in preliminary operation, another at the Shell Refinery, Martinez, Cal., is expected to be in service before the close of the year, while a third at the Union Refinery, Oleum, Cal., is scheduled for completion about the middle of 1941.

In themselves the plants are interesting because they incorporate the experience of the P. G. & E. in high temperature-high pressure operation, combined with semi-outdoor construction. Of equal importance, however, is the fact that the three plants represent a practical and rational solution of the power problem of the larger industrial using large quantities of process steam and power.

Practical difficulties in the balance of steam and electric loads so as to take maximum advantage of byproduct power generation, have led to many different arrangements, including partial or total purchase of steam or power, power interchange agreements, divided ownership of generating facilities and the construction of special utility plants adjacent to the industry.

From the standpoint of operation for both parties, the last arrangement has proven most satisfactory. The two best known plants of this type are: the Louisiana Steam Products Co. (now the Louisiana Station of the Gulf States Utilities Co.) near the Standard Oil refinery at Baton Rouge, La.; and the Southeastern Production Co. serving a paper mill near Mobile, Ala.

The new P. G. & E. plants go a step farther than these two in that they: use extracted steam in industrial evaporators, or, heat transformers, to supply the process steam load; and most important, use condensing turbines for power generation with the generators in parallel with the transmission line system.

With this arrangement maximum advantage can be taken of high efficiency byproduct power generation from a large block of process steam, the high pressure boiler water problem is not unduly complicated and, at the same time, the operation of the station is not definitely tied in with the

Fig. 2. Two data sheets used to record the test readings. These can be changed to meet

DATA SHEET No. 1

Sheet No.....

Evaporation Test Boiler No..... Date.....

Duration of Test..... Class of Fuel.....

Time.	Tank	Tank (A or B)	F. W. Temp.	Water Meter Read. Final	Water Meter Read. Initial	Read Diff. X 100	Water @ 14.81 cu. ft. per Tank	Diff.

DATA SHEET No. 2

Sheet No.....

Evaporation Test Boiler No..... Date.....

Duration of Test..... Fuel Class.....

Note: Water Level in Glass.....inches above lower Nut.

Time	Steam Pres.	Draft Over Fire	Draft Last Pass.	Stack Gas Temp.	Boiler Load	Coal Used	Ash Removed	Volts	Amps.

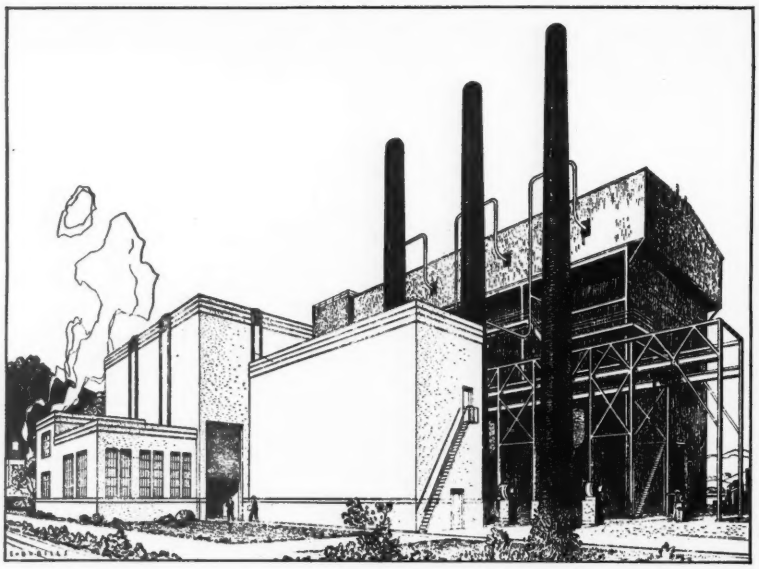


Fig. 1. The three new plants are similar each with three boilers, one main generating unit and industrial evaporators. Boilers are installed outside but with the top gallery enclosed by light corrugated construction. The turbine room, bus and cell structure are enclosed. Each boiler has an economizer and airheater, an individual stack, and individual forced and induced draft fans, both installed on the ground level

industrial demands so that the full capacity of the station is available for the interconnected system if needed.

This P. G. & E. system with 49 hydro and 10 steam plants, now has a total capacity of nearly 1,750,000 hp. which will be increased to nearly 2,000,000 hp. by the addition of the three new plants. The system load is increasing at the rate of about 60,000 kw. annually. The 2,000,000 hp. capacity, together with a number of interconnections with other neighboring companies, is expected to be sufficient until about 1942. Plans beyond this will be coordinated with the Bureau of Reclamation's Central Valley Project, from which power will not be available until about 1944.

The three new plants are similar in design and construction, each with one main turbine, a cooling tower and three boilers designed to burn gas, oil and sludge, largely byproducts of the refinery. Boilers are installed outside with only the top floor enclosed. Some other equipment including derailing heaters and evaporators are also outside. The turbine room, of brick construction, is fully enclosed and houses the main turbine, condensers and auxiliaries, closed heaters, feed and drainage pumps and the boiler and turbine control panels. A separate switch house is provided for the high tension bus and cell structure, but the auxiliary switchgear is installed on the ground floor of the turbine room, in a bay under the control panels.

While the three plants are similar the following remarks apply specifically to the Avon plant which is nearly ready for operation: The main turbine is a General Electric, 28 stage, 3600 r.p.m., 1400 lb., 980 deg. F., 3500 kw. condensing-extraction unit, with sufficient overload valve capacity to carry the 40,000 kw., 12,000 v. generator at full load. The generator is of the hydrogen cooled type and has a main and pilot exciter, both geared to the main shaft and operating at 1772 r.p.m.

The turbine is arranged for automatic extraction of steam at 225 lb. ga. for use in the high side of a Foster Wheeler heat transformer from which 160 lb. steam is supplied to the refinery. The turbine is set longitudinally in the turbine hall and exhausts to a 19,420 sq. ft. Worthington condenser with Worthington auxiliaries. Two 20,000 g.p.m. circulating water pumps in the basement take their suction from the sump of a Foster Wheeler forced draft cooling tower.

Each of the three 200,000 lb. per hr. B. & W. boilers, complete with economizer, air heater and superheater, has an individual stack and individual (Sturtevant) forced draft fans installed on the ground level. Boilers have Bailey automatic combustion control centered on three panels of the berch board type located on the turbine operating floor.

Fuel used will be obtained from the refinery on the following contract basis, covering power, steam and fuel: For electric power there is a demand charge of $6550.00 per mo. up to 5000 kw. with $1.20 per kw. for the demands in excess of this. The energy charge is 0.5 mill plus 0.0021 gal. or equivalent of fuel oil per kilowatt hour. For steam the demand charge is $2000.00 per year for 275 M. lb. per hr. The energy charge is 2 ct. plus 0.265 bbl. of fuel oil per thousand pounds of steam for the first 125,000,000 lb. per mo. and 1.5 ct. plus 0.265 bbl. of oil per thousand pounds for all in excess of 125,000,000 lb. per mo.

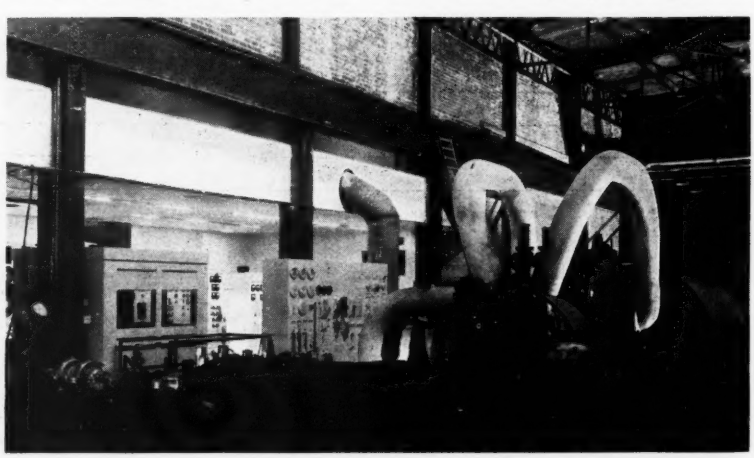


Fig. 2. Recent construction view of the turbine room with two of the boiler feed pumps in the immediate foreground and the turbine panel in the background. Boilers will be fired by gas, oil or sludge under automatic control centered in panels of the berch board type adjacent to the turbine. A corner of one of these boiler panels is visible between the turbine panels

THE INSPECTION OF WOOD

As pointed out by the author, wood, though it is one of the oldest and most common of materials used by man, is less understood than any other construction material. It is for this reason that we believe many will find this practical discussion on wood by Mr. Rossnagel of interest and value.

By W. ELWOOD ROSSNAGEL

Safety Engineer, Insurance Department
Consolidated Edison Co. of New York, Inc.

WOOD is one of the oldest and most common of materials in use today, yet less is understood of its behavior by those who use it than perhaps any other construction material. The average engineer, carpenter, or rigger gives little consideration to the presence of such defects as knots and checks, and perhaps no thought at all to compression failures, compression wood, cross grain, brashy wood, direction of the annual rings, etc.

To get down to fundamentals, wood in general is composed of millions of tiny cells running lengthwise in the tree or log. Fig. 1 shows tiny cubes of both hardwood and softwood highly magnified. Sandwiched between these cells at various places, and extending radially, are long, slender groups of cells known as pith rays, one of the functions of which is to bond the wood together radially.

In the growing tree, only that portion up to about 3" wide beneath the bark consists of living cells. This area is known as sapwood. The darker central portion of the living tree consists of lifeless cells and is as dead as a log. This portion is called heartwood. These two areas may be observed in Fig. 2.

Moisture taken in by the tree roots ascends through those cells constituting the outer portion of the band of sapwood and travels out through the branches to the leaves. Here it combines with carbon from the atmosphere to form the substance commonly known as sap. This sap descends through the phloem or layer between the wood and the bark and there leaves a sticky secretion, part of which develops into wood cells and part into bark.

During the winter season the flow of sap is interrupted. When the rainy spring season arrives, wood cells are produced quite rapidly, with the result that they are large but thin-walled. During the drier summer months the cells produced are smaller but have thicker walls and greater strength. Thus, each year an additional pair of concentric rings is added to the tree, the lighter part being known as springwood and the denser portion as summer-wood. These annual rings vary in width according to climatic conditions, fertility of the soil, exposure to the sun, crowding by adjacent trees, etc.

It is said that a few years ago an ancient Indian village was unearthed out in California. It was found that some of the huts were built on posts similar to piles, and

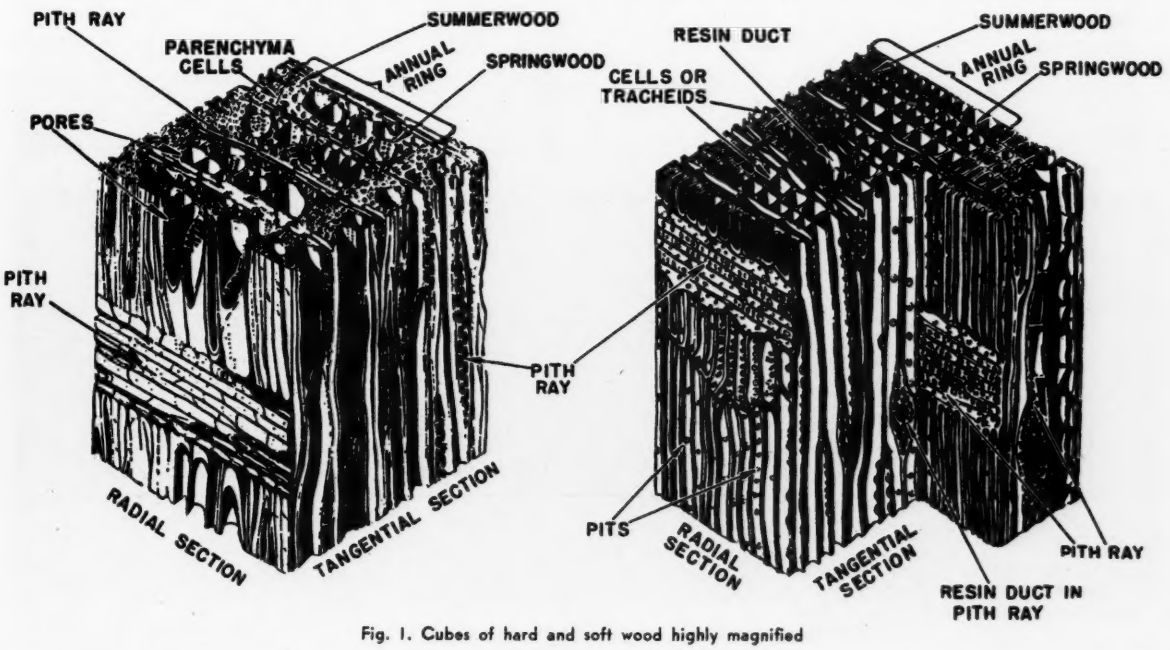


Fig. 1. Cubes of hard and soft wood highly magnified

Fig. 2. Cross section of a tree showing the classification of its structure

a number of these posts were removed and examined by scientists. At about the same time one of the giant redwood trees was cut down not a great distance away. In examining the cross-sections of the Indian posts and the redwood tree, there was observed a marked similarity in certain of the annual rings. In other words, it was evident that the growth of both of these trees was influenced at the same time by the same climatic conditions, such as droughts and rainy years. Counting the rings inward from the bark on the redwood tree, it was a simple matter to determine how many years ago a certain one of those characteristic rings was developed. Then, knowing that the similar annual ring in the Indian post was produced in the same year, it was possible to count outward to the bark. Thus, it was learned in exactly what year the Indians' tree was cut down and the hut built. Here is found a historical use for the annual rings in a tree in addition to the technical use which will be discussed later.

Domestic woods are divided into two classes, hardwoods and softwoods. However, all hardwoods are not hard, and all softwoods are not soft. Longleaf yellow pine, for instance, is nominally a softwood, while poplar (better known as whitewood) is called a hardwood. The answer is that woods are classed botanically rather than technically. In other words, the wood from all coniferous or evergreen trees is known as softwood, while hardwoods are the product of broadleafed trees.

Fig. 4. (Above.) The most common defect is the knot which is the intersection of a branch with the trunk or larger limb of a tree

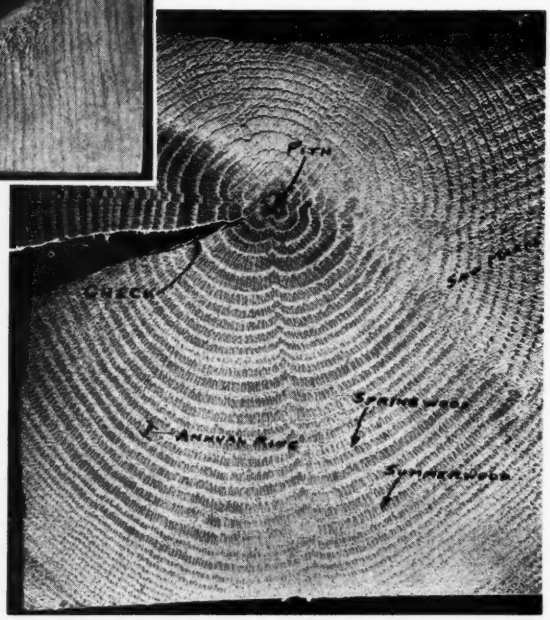


Fig. 5. (Right.) The next most common defect is the check, a longitudinal split extending radially on the cross section

Softwoods are considered nonporous in structure, while hardwoods, which are called porous, are divided into two classes. Woods such as the oaks, hickory, chestnut, and ash have their pores arranged in definite lines in the springwood of the annual rings and are thus known as ring-porous. On the other hand, maple, gum, walnut and poplar have pores of gradually diminishing size from large in the springwood to small and widely spaced in the late summerwood. This type is known as diffuse-porous wood. These three classes of wood structure are shown greatly magnified in Fig. 3.

In order to cover as much ground as possible in the limited space, first one defect, then another, will be considered. The

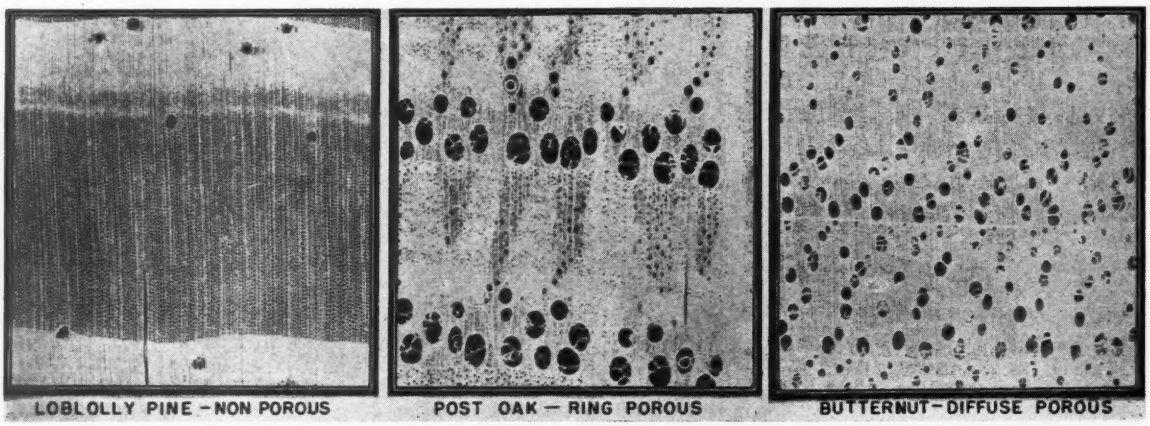


Fig. 3. The three classes of wood structure

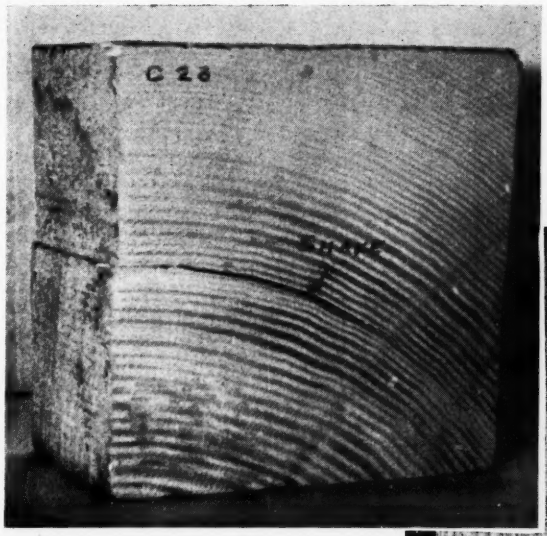


Fig. 6. (Left.) Shades are circular separations between the annual rings

Fig. 7. (Below.) Pitch pockets are not necessarily objectionable

most common defect is the knot which is the intersection of a branch with the trunk or larger limb of the tree. See Fig. 4. In general, all knots should be avoided, so far as possible, in structural timbers. Firmly intergrown knots are permitted in the compression side of a beam, but a sound knot on the tension side of a beam reduces the strength as much as, or even more than, an open knot hole, as a knot cannot transmit tensil stress. Also, the dip grain adjacent to the knot may cause a loss of strength even greater than that caused by knot. On the other hand, a sound knot located near the end of a short deep beam may actually be an asset, as in this case it may act as a key or pin to prevent slippage of the fibres on each other due to horizontal shearing action along the neutral plane. In long columns where stiffness is the controlling factor knots have very little effect upon the strength.

The next most common defect is the check. This is a longitudinal split extending radially on the cross-section (Fig. 5), which is caused by rapid drying or seasoning, in which process the cells shrink more in a tangential (to the annual rings) direction than radially, and unless extreme care is exercised tears the wood apart. In measuring checks, it is the length and depth which are of importance, an almost inperceptible split being as detrimental as a wide one. Checks, as a rule, are not highly objectionable unless they occur near the ends of a beam, at the neutral axis, especially on short, deep beams where they greatly reduce the resistance to horizontal shear. Checks have practically no ill effect on columns in which the length is less than eleven nor more than thirty times the least dimension. They also are not objectionable in poles, except insofar as they permit the entrance of moisture.

Shakes are similar in effect to checks. They, however, extend in the opposite direction, being circular separations between the annual rings (see Fig. 6), and are the result of lack of bond. Like checks, they should not be permitted at points of maximum horizontal shearing stress.

Pitch pockets are much worse in appearance than in fact. They occur only in pines, spruce Douglas fir and tamarack, and unless exceptionally large or numerous are not objectionable. See Fig. 7.

A very confusing defect is cross-grain. This general term includes diagonal grain, spiral grain, crooked grain, dip grain and interlocked grain. The markings on the faces of a piece of wood indicate the intersection of the concentric annual rings with those of the piece, but do not necessarily indicate the direction of the grain. Fig. 8 shows diagonal grain on the radial or edge-grain face of the piece of wood. It is the result of cutting from a crooked log, the edge of the piece being not parallel with the pith or axis of the log. On the radial face of the piece the markings do indicate the presence or absence of diagonal grain, but only so far as that face is concerned.

Spiral grain (Fig. 9), which is the result of the fibres of the wood growing spirally in the tree, can be detected on the tangential or flat-grain face by various methods. The direction of the checks is always a positive indication of the grain. In certain softwoods (those which were just said to produce pitch pockets) the resin ducts show the direction of the grain. These are the marks which have the appearance of tiny pin scratches on the flat grain surface. In many hardwoods, the direction of the pores on the

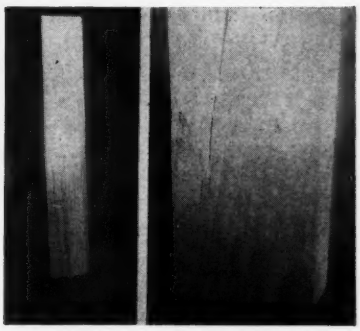


Fig. 8. (Left.) Diagonal grain
Fig. 9. (Right.) Spiral grain

longer pith rays give infallible signs of direction of the grain.

If no other indicator is present a sharp pointed knife may be used to pick up a splinter and observe the direction in which the fibres pull; or the point of a pen may be touched to the surfaces of the wood, the ink being drawn by capillary action into the cells of the wood and presenting the appearance of a small line on the surface.

Ed. Note: This is the first of two articles by Mr. Rossnagel on this subject. A second will appear in a subsequent issue.

Sulphur As a Fuel

With the possibility of making large quantities of sulphuric acid as by-products of the copper smelting, petroleum refining and power plant flue gases, it is surprising to learn that there are some 60 plants burning sulphur as a means of producing commercial sulphuric acid by the contact process.

The process is described in this article. The boiler used serves two purposes: first cooling the gases from about 1500 down to 780 or 800 deg. F. for maximum conversion of SO_2 to SO_3; to furnish steam to run the equipment. Oil is used to start the plant and supply steam for melting the sulphur but when the sulphur is started burning the oil burner is removed. After the SO_2 from combustion is converted to SO_3 it is absorbed in 98 per cent acid which increases to 99.5 per cent before being cut back to 98 per cent with water. In a new plant a supply of 98 per cent acid must be shipped in. The catalyst in the conversion of SO_2 to SO_3 is vanadium and about 80 per cent conversion takes place in the first 30 per cent of the catalyst, leaving only 20 per cent to be converted by the remaining 70 per cent of the metal.

By WALTER H. HARVEY

COAL was first used as a fuel in England in the thirteenth century and its demand was developed with the introduction of steam driven machinery. Our system of manufacture might not have developed as it has if it were not for coal. Since coal was first used to generate steam many different combustibles have been used. Steam is now being generated from all kinds of fuel from cocoa shells to coal.

All our coals contain sulphur and our middle west coals are high in sulphur content. The products of sulphur contribute to a reduced heat transfer of the heating surface, they also corrode the boiler metal and equipment. In industrial districts the SO_2 in the flue gases produce a serious corrosion problem and in sections where there is vegetation it is very deadly to plant life. Sulphur is a basic raw chemical material and is indispensable in the manufacture of rubber, paper, gasoline, explosives, dyes, steel, fertilizer, drugs and many other products.

Great Britain has no deposits of sulphur and it must import or else recover it as a by product, therefor greater progress had been made there in the investigating of the possibilities of recovering the SO_2 from the flue gases* than has been made in the United States. There are several reasons for this: English laws or local ordinances require the removal of flyash and cinders; the cost and maintenance of such apparatus is considerable, now if the SO_2 in the flue gases could be removed at the same time, the sale of by product SO_2, which is vitally needed would help to pay for and maintain the equipment.

England must import or recover as a by product its sulphur and since the sulphur content of British coals is considerably less than ours the cost of salvaging apparatus would be less. The cost of the SO_2 recovery process in the United States due to the sulphur content of our coals, especially our middle west coals, could not compete with the production of sulphuric acid from natural brimstone.

The writer has had the experience of operating one of the few plants where steam is generated entirely from sulphur. At present about 30,000 lb. are burned per day. The sulphur has a heating value of about 4000 B.t.u. per lb. This sulphur is of course burned to SO_2 gas which passes through a 35 hp. boiler then through a convertor where about 98 per cent of the SO_2 is converted into SO_3 gas for the production of sulphuric acid.

Sulphur is received in the crystalline form and dumped into a hopper, carried by a bucket elevator to a melter with a capacity of 40 t. per day and melted by steam coils with 80 lb. steam pressure. From the melter it flows by gravity to a 40 t. settler where it is kept at 280-290 deg. F. by steam coils.

From the settler it is pumped by a Viking rotary pump into the top of a burner where it is mixed with air at 120 deg. F. which is dried and heated in a drying tower and supplied by a constant pressure blower. In burning there is no refuse left and the SO_2 gas enters the boiler at 1300 to 1600 deg. F. The temperature of the burner is determined by the amount of sulphur and the amount of air entering the burner for combustion.

The boiler acts as a cooler for the SO_2 gas and also furnishes steam for the melter, settler, feed water pump and a 65 hp. engine that drives a constant pressure blower. At present the excess steam is bled to the atmosphere but arrangements are being made to condense all surplus steam and use the condensate for boiler feed.

From the time the sulphur is melted until it reaches the burner it is surrounded by steam jacked

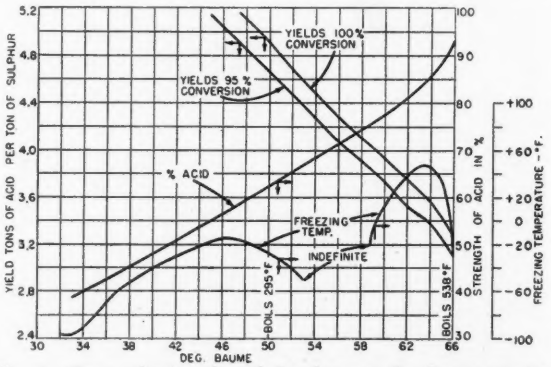


Fig. 1. Curves showing the relation between the Baume gravity of sulphuric acid and its strength in per cent; yield per ton of sulphur with 90 and 100 per cent conversion; and variation in freezing point. Conversion data calculated from operation, remaining data based on tables of the Mfg. Chemists Assn.

*For work in this direction see the following articles: Flue Gases Laundered to Prevent Air Pollution, by Dr. R. V. Kleinschmidt, p. 393, June 1938; Dr. Johnstone on Sulphur Removal, by Dr. H. F. Johnstone, p. 538, August 1938; Removal of Sulphur from Flue Gases by A. W. Anthony, Jr., p. 725, November, 1938; and Sulphur from Flue Gases, p. 307, May 1939.

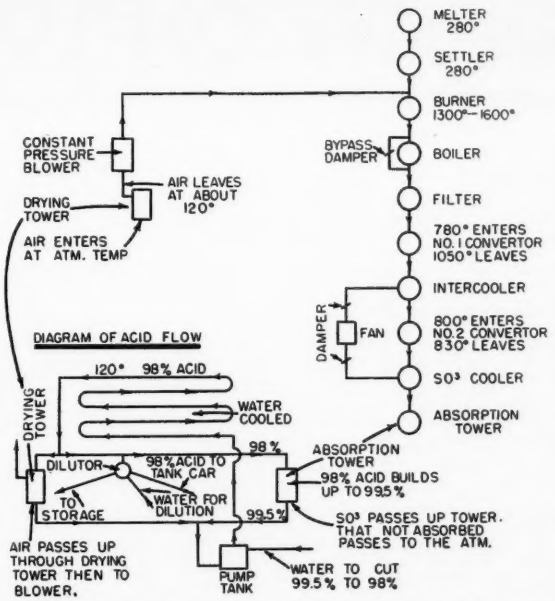


Fig. 2. Gas flow diagram of the plant. The acid returning to the pump tank is cut down to 98 per cent by the addition of water. The acid level in the pump tank is kept at about 5 ft., the excess being taken to the dilutor and cut to 60 to 66 Be for storage. When 98 per cent acid is sold, water is shut off at the dilutor and the acid piped direct to tank cars.

lines at 80 lb. pressure. All condensate and exhaust steam returns to an open feedwater heater held at 6 lb. pressure. From the heater several steam lines run out to steam jacket water lines that are exposed to the weather.

Gases leave the boiler at close to 780 deg., that temperature is maintained by regulating a by pass valve between the boiler and burner where some of the hot gases may be by passed into the line containing the cooled SO_2 gases, then pass through a filter where any foreign matter may be taken out. From the filter the gases enter the No. 1 convertor at 780 deg. F. and a large percentage leaves as SO_3 gas at about 1050 deg. F.

Before passing through the No. 2 convertor these gases pass through an intermediate cooler where they are cooled down to about 800 deg. F. and leave the second convertor about 830 deg. F.

In passing through the convertor which is filled with the catalyst vanadium, there is a heat rise due to the picking up of one more molecule of oxygen. The SO_2 that is not converted to SO_3 in the first convertor takes place in the second, hence the smaller heat rise. The percentage of capacity the plant operates at determines the per cent of conversion from SO_2 to SO_3 which runs from 96 to 98 per cent. The SO_3 leaving No. 2 convertor passes through a SO_3 cooler before it enters the bottom of the absorption tower. The SO_3 passes up through a bed of quartz and 98 per cent sulphuric acid coming down through this bed of quartz absorbs the SO_3 gas and builds up in strength.

After the acid reaches the bottom of the absorption tower it has absorbed all the SO_3 it can and flows back to the tank from where it was pumped and is diluted back to 98 per cent before entering the absorption tower for another cycle. The small amount of SO_3 that is not absorbed passes out the stack to the atmosphere.

On dilution of acid with water there is a great heat rise, requiring the acid to be circulated through a cooling coil. The SO_3 gas is abosrbed quicker if the acid is cooled down to 120 deg. F. This type of sulphuric acid plant makes use of the contact method and 98 per cent strength acid is needed to start with.

Air needed for combustion passes through a drying tower where it is also heated as it passes up through the hot acid coming down through a bed of quartz. Above the level where the acid enters the drying tower there is a thick layer of small quartz. This takes out any moisture that may have been picked up and the air enters the blower moisture free. When running about 8 per cent SO_2 there is about 8¼ in. of water on the suction side of the blower and about 54½ in. on the exit side of the blower at a speed of 269 r.p.m.

Acid and water are both metered at a dilutor to obtain the desired product strength if 98 per cent acid is not called for. The acid in the dilutor is cooled by running well water through coils, this water then flows over the coils that cool the 98 per cent acid, then runs to the sewer. The 98 per cent acid is pumped through the system by a Lewis submerged vertical acid pump, capacity 210 g.p.m. at a 45 ft. head and 1720 r.p.m. A vertical Troy-Engberg engine drives a Roots-Connersville constant pressure blower.

The boiler is a Combustion Engineering 425 sq. ft. waste heat horizontal fire tube type designed for 200 lb. pressure. The boiler is equipped with a Swartwout S-C feedwater regulator. The feedwater is supplied to Worthington duplex pump from a Swartwout open type feedwater heater installed about 25 ft. above the pump. City water, used in the boiler, is softened by an Elgin zeolite softener.

From an engineering point of view this plant was an ideal situation for the designers, because the latest advances in equipment, efficiency and design could be practiced without the handicap of obsolete equipment and materials interfering with present day ideas and designs.

EACH ton of bituminous coal mined in the United States brings to the miner $1.27 in wages. That is the average per ton labor cost at the present time. The labor cost in the production of four barrels of fuel oil, the equivalent of one ton of coal, is 68 cents. The labor cost in the production of 20,000 cubic feet of natural gas, the fuel equivalent to a ton of coal, is only 8 cents. And the labor cost in 2,000 kw-hr. of hydro-electric power (energy equivalent to a ton of coal) is less than one cent.—T. A. Day, in an address before the Va. Coal Merchants Assn.

Correction. Sulphur Burner Applied to F. W. Treatment

OUR ATTENTION has been directed to an error in the article under the above title in the May issue of POWER PLANT ENGINEERING. In the graph, Fig. 4 on Page 56, the data along the vertical side should refer to SO_2 instead of CO_2.

VOLTAGE REGULATION ON LOW V

By P. E. BENNER
Central Station Engineering Dept.
General Electric Company

The modern incandescent lamp is a wonderfully flexible and effective device but it demands one essential requirement—correct line voltage. A ten per cent overvoltage will reduce its life 75 percent; a ten per cent undervoltage on the other hand decreases the light output by 30 per cent. Motors are similarly affected by voltage fluctuations, though to a smaller degree. These facts emphasize the need for close voltage regulation. ¶ In the early days of the art, voltage regulators were cumbersome devices sluggish in their operation and expensive, but as in all things, development in this field has brought the modern voltage regulator to a high standard of perfection and within reach of all as far as cost is concerned. In this article, the author discusses the operating characteristics of regulators suitable for use on low voltage light and power circuits. These are compact, self-contained devices, automatic or non-automatic and permit of easy installation.

GOOD VOLTAGE required for the proper and successful operation of electrical equipment is no longer a luxury. Small-capacity low-voltage air-cooled automatic voltage regulators now provide an economical means for extending the benefits of good voltage to every nook and corner of power stations and manufacturing plants.

Overvoltage as well as undervoltage produces undesirable results. A 10 per cent overvoltage reduces lamp life 75 per cent, decreases the power factor of general purpose motors from 3 points at full load to 5 to 6 points at half load, and causes overheating in various potential devices. A 10 per cent undervoltage on the other hand decreases the light output of Mazda Lamps approximately 30 per cent, increases the temperature rise of general purpose motors 6 to 7 degrees C, reduces their torque and overload capacity approximately 19 per cent and may result in sluggish operation of potential control devices. The speed of induction motors varies to some extent with the voltage but not as seriously as in the case of high-speed series motors which are sometimes used in manufacturing processes.

Power Station Lighting and Control Circuits

The generator bus voltage of power stations is frequently varied to compensate for feeder drop to utilization point. If, during times of peak load, the voltage is raised any great amount this will result in a corresponding overvoltage on the lighting and control circuits in the power plant itself. At other times it may be desirable to hold lower than normal voltage on the generating bus to obtain a desired division of reactive kv-a. throughout the system. Correct voltage can be maintained at all times on the lighting and control power bus by means of air-cooled regulators connected in the secondary of the lighting and control power transformer bank. The air-cooled design makes it possible to install such a regulator in any available space in the power station.

As pointed out, high or low voltage adversely affects the operating characteristics of motors and Mazda Lamps. Of primary importance, however, is the relation between voltage and plant production or efficiency. Where automatic machinery is driven by general purpose induction motors, 10 per cent undervoltage will result in a 1½ per cent decrease in production. In applications where starting and running torque are important such as on punch presses, shapers, planers, reciprocating pumps, cranes and hoists, a 19 per cent reduction in torque would appreciably affect the average speed and therefore the output particularly if the duty involves frequent acceleration.

Where motors are closely applied either in regard to starting or running torque low voltage may actually result in failure to start or cause the equipment to stall. Also the higher operating temperatures resulting from undervoltage operation will probably eventually result in increased maintenance.

If the operation of non-automatic equipment and in assembly lines full light output from lamps is necessary to maintain production schedules and keep spoilage to a minimum. With the trend towards increased illumination, light circuits are frequently overloaded from the standpoint of voltage drop before they are overloaded from actual amperes. In such cases it is usually found to be much more economical to compensate for voltage drop by means of regulating equipment rather than to eliminate it by increasing the number of circuits or the actual conductor size.

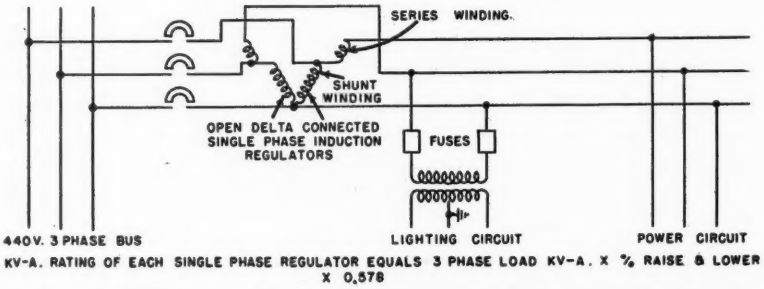

SERIES WINDING
SHUNT WINDING
OPEN DELTA CONNECTED SINGLE PHASE INDUCTION REGULATORS
FUSES
440V. 3 PHASE BUS
LIGHTING CIRCUIT
POWER CIRCUIT
KV-A. RATING OF EACH SINGLE PHASE REGULATOR EQUALS 3 PHASE LOAD KV-A. X % RAISE & LOWER X 0.578

Fig. 1. Schematic diagram of 2 open delta connected single phase induction regulators for voltage regulation of a three phase, 3 wire combined light and power circuit

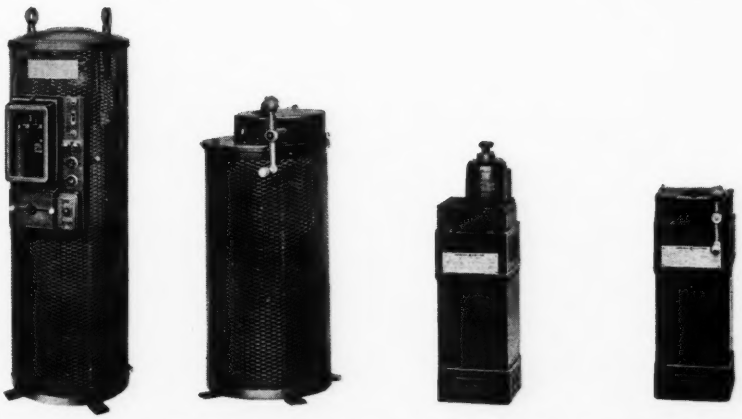


Fig. 3. Automatic, manual and motor operated single phase, natural draft air cooled, induction regulators rated 1.2 to 12 Kva 600 volts and below

The air cooled regulators rated 1.2 to 12 kv-a., 60 cycles, single phase, and from 120 to 600 v., Fig. 3, are admirably suited for the automatic regulation of low voltage light and power circuits. These regulators contain no oil, and so need no enclosing vaults, which make them especially adaptable to installation in manufacturing plants and power stations.

The kv-a. ratings of the regulators as mentioned above are on the basis of actual physical sizes. The actual load which any particular rating will handle is equal to the kv-a. rating divided by the per cent raise and lower. For example, a 6 kv-a., 10 per cent raise and lower regulator will actually handle a 60 kv-a. circuit. Figuring the other way around a 120 kv-a. load requiring 5 per cent regulation would require a 6 kv-a. regulator. This applies to single-phase circuits and three-phase, 4-wire circuits, where the regulators are connected line to neutral. In the case of three-phase, three-wire delta circuits it is common to use two regulators connected open delta as shown in Fig. 1. The rating of each single-phase regulator required for such an open delta connection is equal to ½ the 3-phase circuit kv-a. times the per cent regulation divided by 0.866. The factor 0.866 is included in because in the case of the open delta connection, an angular displacement of 30 deg. obtains between the voltage and current in the series winding. In all cases the rating of regulator is equal to the product of the line current and the maximum volts induced in the series winding, which of course is the excitation voltage of the regulator times the per cent raise and lower.

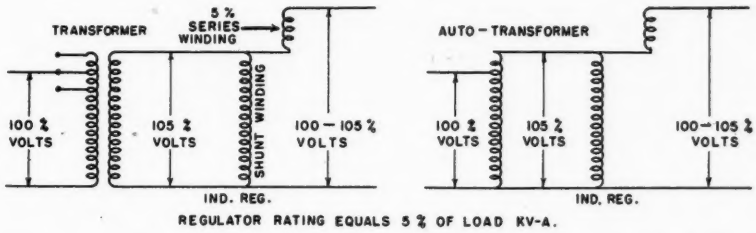


Fig. 2. Suggested use of transformer taps or an auto transformer to utilize the full buck and boost range of an induction regulator

Induction regulators inherently have a raise as well as a lower range. For instance, a 5 per cent regulator can vary the voltage a total of 10 per cent. By proper selection of transformer taps or by use of an auto transformer as shown in Fig. 2 it is possible to use the full range of the regulator in compensating for line drop. In this way the 6 kv-a. plus or minus 5 per cent regulator will provide for 10 per cent regulation in a 120 kv-a. circuit.

The open delta connection of regulators could be used in a three-phase 440 or 550 v. power or combined power and light circuit such as shown in Fig. 1. Lighting circuits would be supplied by means of single phase air cooled transformers having a single phase, three-wire, 120/240 v. secondary. In this type of circuit regulators could be located at the substation or at the load or in the case of a widely distributed load at the substation and also in the loaded part of the circuit. If regulators are located only at the substation, it would usually be advisable to provide for holding voltage at the load by means of line drop compensators. The line drop compensator is a device which, by means of resistance and reactance adjustment, makes it possible to hold a constant voltage at some point on the feeder remote from the regulator location. When the regulator is located at the load, it is of course unnecessary to provide for line drop compensation.

In some cases the lighting circuits are taken directly from a 2400-v. feeder, in which case it is possible to utilize equipment such as is shown in Fig. 4. The transformer, which is of the non-inflammable Pyranol type, is used to step down from 2400 v. to 120/240 v. for lighting, and the regulator is connected in the 120/240-v. circuit. When used on single-phase 120/240-v. three-wire circuits, the series or buck and boost winding of the regulator is divided into two sections, one section being in each of the two outside wires of the three-wire circuit. In this way equal regulation is obtained in each side of the circuit.

This type of service has also been provided by means of a self-

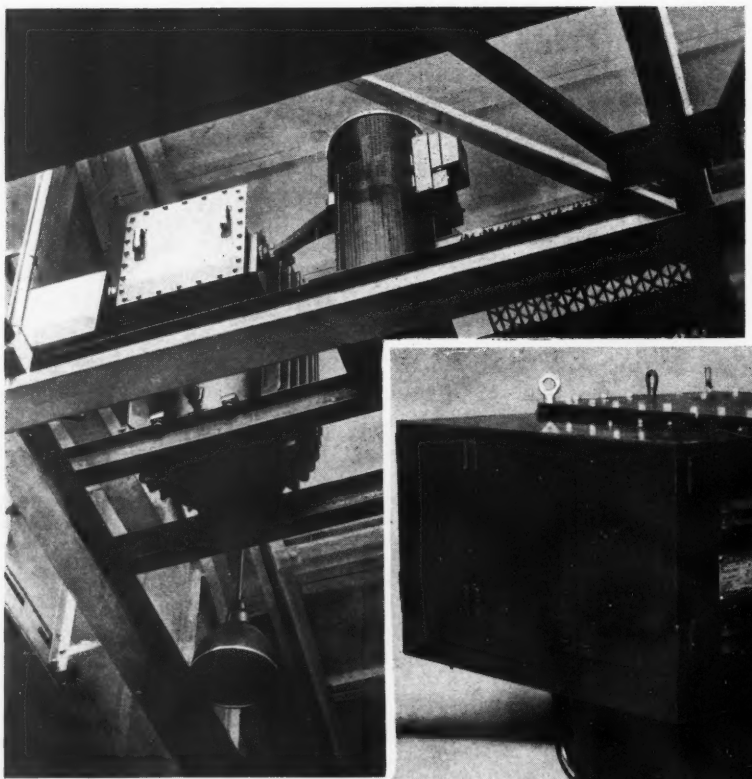
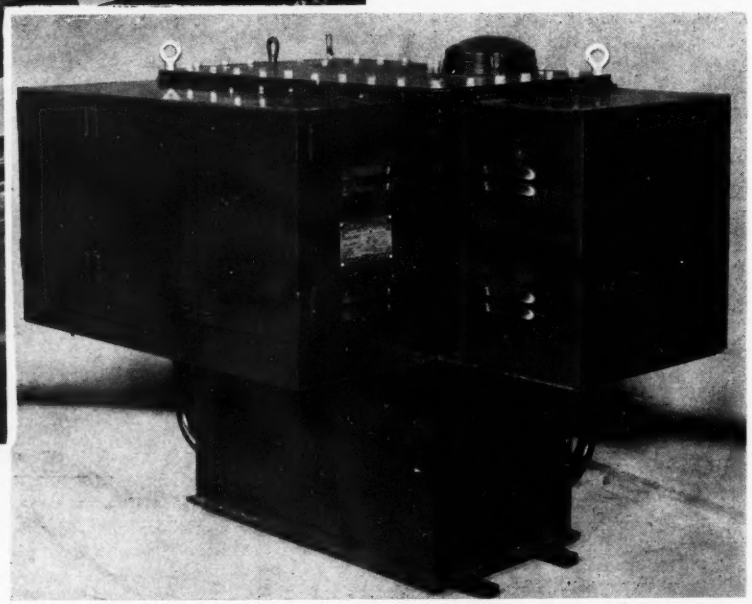


Fig. 4. (Left.) Factory installation of a 100 Kva 2400 volt—120/240 v single phase transformer and a 12 Kva 240 volt single phase, double secondary air cooled induction regulator for regulating factory lighting circuits

Fig. 5. (Below.) Self-contained Pyranol Load-center power unit rated 100 Kva single phase 2400—120/240 volts—60 cycles which includes transformers, induction regulator, high voltage metal-enclosed fuse cutouts, and low voltage air circuit breakers for 2 distribution circuits



contained, Pyranol load center power unit (Fig. 5) in which the regulator is contained in the same tank as the transformer, with low voltage air circuit breakers and high voltage fuse cutouts as an integral part of the unit.

Non-Automatic Regulators

In addition to the automatically controlled regulators for light and power circuit regulation, this type of regulator when used in laboratories or for testing is sometimes arranged for manually controlled motor operation, or hand operation. As one of the many and varied uses in this connection the regulator might be required to vary the voltage from 0 to 100 per cent. Such a variation could be obtained by means of a 100 per cent regulator, in which case only the lower range of the regulator would be utilized and the kv-a. of the regulator would be equal to the kv-a. of the load. The same range of regulation for the same load could be provided by means of a 50 per cent raise and lower regulator and 2:1 auto transformer as shown in Fig. 6, which would require only ½ the kv-a. of actual regulator capacity.

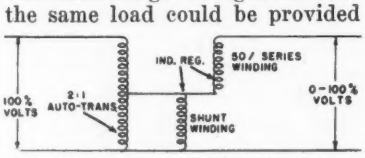


Fig. 6. Suggested arrangement of induction regulator and auto-transformer for controlling the voltage between 0 and 100%

Another frequent use of the motor operated regulator is for electric ovens in which case the temperature can be automatically controlled by means of a thermostat acting on the motor circuit, thus varying the voltage and consequently the heat input to the oven itself.

New Sound Meter Has 24 to 120 DB. Range

A NEW portable sound-level meter, lighter and more compact than any previous instrument of this kind, has been built by Walter Mikelson and others of the General Electric general engineering laboratory. It weighs only 19 lb. but has a range of 24 to 120 decibels or roughly from the rustle of leaves to the scream of a factory whistle.

The new meter may be used quickly and conveniently for almost any kind of noise study, including airplane engine, cabin and propeller noises; traffic noise; sound in theaters, auditoriums and radio studios; and noises of motors, fans, generators, turbines, pumps, bearings, gears, cylinders and other parts of machinery.

Essential parts of the device are a microphone, an amplifier and an indicating instrument. An arm extension protects the microphone from sound reflected from the case. The amplifier consists of five stages which are resistance coupled. The battery-operated tubes are mounted on a shock-proof base, thus reducing errors due to vibration.

A switch permits the selection of one or three ear-weighting networks, 40 decibels, 70 decibels or flat frequency response giving the instrument a response similar to that of the human ear. In field use the instrument is calibrated by applying a precision mouth-blown calibrating unit to the microphone. After adjustment a single knob controls the instrument.

Light Load Diesel Pays

Bradford Dyeing Assn. installs 50 kw. unit in its steam plant to carry week-end load and saves 75 per cent of the investment in 43 days of operation

WHILE THE ADVANTAGES of an internal combustion engine in conjunction with a steam plant to carry week end and light electric loads are well recognized, it is difficult to find such plants with costs segregated to show the "before" and "after" figures. For this reason the recent installation at the Bradford Dyeing Association plant on the Pawcatuck River at Westerly, R. I., is particularly interesting.

The original plant built in 1911-12, for the quality finishing and dyeing of fabric goods, is of one story sawtooth construction. In May, 1939, a Model D 8800 Caterpillar Diesel was installed, direct connected to a 60 hp. d.c. motor which was on hand and now serves as a generator. The total cost, completely erected, was $3,613.46 which includes $358.18 for an auxiliary motor driven oil pumping outfit and storage tank for use with the regular heavy oil system for starting the oil fired boilers.

While part of the steam plant, this is considered as part of the Diesel generator scheme for it serves as a speedy and economical method of reverting back to steam plant operation. Ordinarily heavy bunker C oil is used on the boilers. "Bottled up" with the dampers and stop valves closed, the tight settings hold the heat well, the pressure drops only to about 50 lb. in 48 hr. and they can be brought to full pressure in a few minutes.

In case of longer outages or cold boilers, the motor driven pump, supplied with power from the Diesel and taking its suction from the new 255 gal. tank of No. 2 oil, which needs no heating, is used for raising steam. Three of the company's 10 boilers are oil fired, the remaining seven are coal fired.

The Diesel unit will carry a peak as high as 50 kw., or sufficient to carry the machine shop load, pump water for spraying over the wooden rollers on the finishing machines to keep them checking and cracking, and for other auxiliary uses around the plant.

Carrying the week end and holiday loads on the engines makes it possible to shut down the steam plant in the summer. Fire protection, originally afforded by a steam driven pump, was taken care of by connecting the sprinkler system to the local water system which, with a local 50,000 gal. storage tank, is considered adequate, especially so since in an emergency the boilers could be put into service quickly.

From the date of installation through to the end of 1939, the Diesel generator set operated 43 da. or a total of 1038 hr. and generated 22,294 kw-hr. During this period 2642 gal. of fuel oil costing $200.52 and 70 gal. of lub. oil, costing $42, were used, the total operating cost of $242.52 amounting to slightly under 9 mills per kw-hr. as compared to 13.36 cents per kw-hr. by the old method.

To arrive at a fair basis of comparison, Stuart Cruickshank, Jr., power engineer of the company, added to the above 1365 gal. of fuel oil costing $81.90, used in raising steam to revert to steam plant operation. This brings the total cost of the week end service to $324.42. For accomplishing the same purpose, the steam plant used on an average of 120 gal. of No. 6 fuel oil per hr. and would have cost roughly $3500.00.

Figuring conservatively at 100 gal. per hr., or 2471 bbl. for the 43 da., the oil cost alone would have been $2978.54, the Diesel thus showing a net saving of $2654.12 for less than an 8 mo. operating period. Stated another way, the total cost of the Diesel set, first cost plus operating expenses for the period was $3937.88. Against this must be balanced the estimated cost of steam plant operation of $2988.54 which leaves only $959.34, roughly 25 per cent of the first cost of the engine unpaid for, with the engine itself hardly broken in.

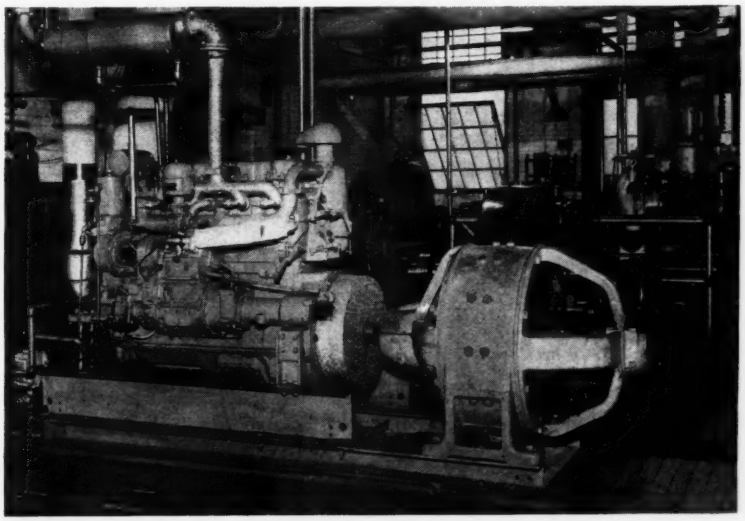


Fig. 1. This unit installed at a cost of about $3600 saved about $3000 in fuel during less than 8 mo. of operation

Simultaneous Firing of Gas and Pulverized Coal*

By H. A. KLEINMAN, Engineer
Peoples Power Co.
Moline, Ill.

DURING THE PAST 8 or 9 yr. natural gas has been supplied to many communities in the Midwest, and, as a result of the load factors on the domestic, commercial, and industrial business, a certain amount of gas has been available for boiler gas on an "interruptible" basis. In this case "interruptible" means that the customer agrees to discontinue the use of boiler gas at any time requested and for any duration of time upon very short notice, which may be one or 24 hr., depending upon conditions.

It follows then, that for continuous operation, the boiler-gas customer must be prepared to burn more than one fuel. Boilers equipped to burn gas are usually also equipped to burn oil or coal, because it is advantageous to change fuels under the same boiler rather than put on a coal or oil-fired boiler to replace a gas-fired boiler and then reverse the procedure when gas is again available. In order to meet these conditions, a number of combination arrangements are in service, such as gas and oil burners, gas burners and stokers, and gas and pulverized coal burners.

Gas and pulverized coal is a common and practical combination with the boilers so arranged that the change from one fuel to the other can be made in a few minutes without disturbance. In this case, of course, both fuels may be burned simultaneously when the supply of gas is limited to a definite daily amount not sufficient to provide the required steam output.

Combustion of Coal and Gas

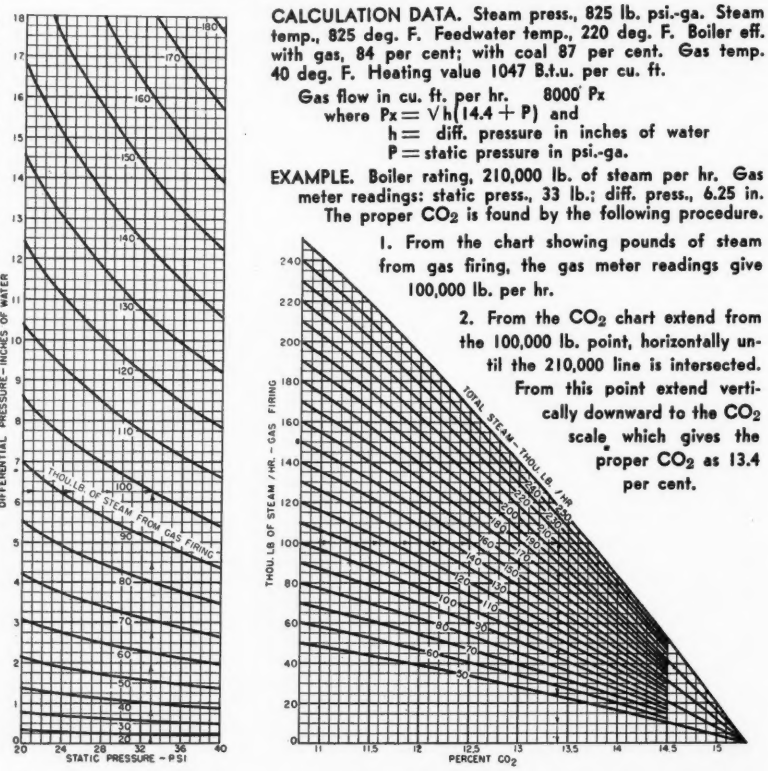
One pound of coal can be completely burned with 20 per cent excess air giving a CO_2 of 15.3 per cent, requiring 9 lb. of air from the forced draft fan and forming 10 lb. of flue gases which will occupy 125 cu. ft. at 60 deg. F., 30 in. Hg. and have a density of 1.025 referred to air. In passing through the unit, there is a certain amount of air infiltration and leakage which increases the gas volume to 136 cu. ft. at 60 deg. F. 30 in. Hg. weighing 10.6 lbs., which is the gas handled by the induced draft fan, of which one-half pound is water vapor.

Actual volumes of the flue gases vary with the temperature and it is interesting to note that if the entire 10,000 B.t.u. liberated from 1 lb. of coal appears as sensible heat in the flue gases, the temperature of the flue gases will be 3500 deg. F. and the flue from one pound of coal will occupy 950 cu. ft. in the furnace. As the sensible heat is absorbed from the flue gases the volume decreases until at the release temperature of 320 deg. F. the flue gases from 1 lb. of coal occupy 203 cu. ft. which is the actual volume handled at the induced draft fan.

On the other hand 10 cu. ft. or ½ lb. of natural gas can be completely burned with 10 per cent excess air giving a CO_2 of 10.8 per cent requiring 8 lb. of air from the forced draft fan and forming 8.5 lb. of flue gases which will occupy 115 cu. ft. at 60 deg. F. 30 in. Hg. and have a density of 0.965 referred to air. Air infiltration will increase the volume to 124 cu. ft. and the weight to 9.2 lb. by the time it passes through the induced draft fan, of which one pound will be water vapor.

Actual volumes of the flue gases from 10 cu. ft. of gas will

*The text of this article was abstrated from a paper "Intermittent Burning of Gas and Pulverized Coal" presented by the author before the 1940 Midwest Power Conference. The comparative figures given are based on 10,000 B.t.u., i.e., one pound of 10,000 B.t.u. coal and ½ lb. (10 cu. ft.) of natural gas. The chart is a reproduction of the one used as a firing guide in the Riverside Station on the new 825 lb. ga., 825 deg. F. boiler No. 5.


DIFFERENTIAL PRESSURE – INCHES OF WATER
STATIC PRESSURE – PSI
THOU LB OF STEAM FROM GAS FIRING
THOU LB OF STEAM / HR. – GAS FIRING
TOTAL STEAM – THOU LB. / HR
PERCENT CO_2

CALCULATION DATA. Steam press., 825 lb. psi.-ga. Steam temp., 825 deg. F. Feedwater temp., 220 deg. F. Boiler eff. with gas, 84 per cent; with coal 87 per cent. Gas temp. 40 deg. F. Heating value 1047 B.t.u. per cu. ft.

Gas flow in cu. ft. per hr. $= \frac{8000\ Px}{\sqrt{h(14.4 + P)}}$ and

h = diff. pressure in inches of water
P = static pressure in psi.-ga.

EXAMPLE. Boiler rating, 210,000 lb. of steam per hr. Gas meter readings: static press., 33 lb.; diff. press., 6.25 in. The proper CO_2 is found by the following procedure.

1. From the chart showing pounds of steam from gas firing, the gas meter readings give 100,000 lb. per hr.

2. From the CO_2 chart extend from the 100,000 lb. point, horizontally until the 210,000 line is intersected. From this point extend vertically downward to the CO_2 scale which gives the proper CO_2 as 13.4 per cent.

Fig. 1. Gas-Coal CO_2 chart used as a firing guide at Riverside Station when burning gas and pulverized coal on No. 5 boiler. A cross section of the boiler is shown by Fig. 2. The chart is based on the data indicated and its use explained by the detailed example and arrows

be 920 cu. ft. in the furnace for a temperature of 3740 deg. F., based on the assumption that all heat of combustion appears as sensible heat in the flue gases. This volume is decreased as the heat is absorbed by the heating surfaces until at the release temperature of 295 deg. F. the flue gases from 10 cu. ft. or ½ lb. of natural gas occupy 180 cu. ft. which is the actual volume handled at the induced draft fan.

This comparison shows that the volume of air and flue gas and the resulting velocities are less when burning gas than when burning coal, which means that less fan power is required to burn gas than to burn coal, or conversely the same fan power will develop

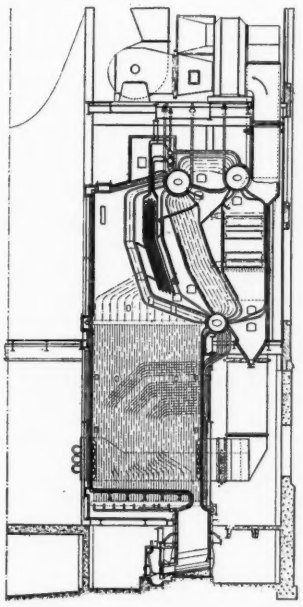


Fig. 2. No. 5 boiler at Riverside Station has a completely water cooled, continuous slag tap furnace with tangential firing, a convection superheater with bypass control of superheat, an economizer and a regenerative type air heater

a higher output when gas is the fuel than will be developed when coal is the fuel. The comparison also shows twice as much water vapor in the flue gas as in the flue gases from coal. The practical significance of this is in its effect on the efficiency of the unit and on the dew point of the flue gases. The affect of the efficiency of the unit will be referred to again and in regard to dew points we will only say that condensation in the economizer and air heater will occur at a higher temperature when burning gas than it will when burning coal. This effect should be given careful consideration in regard to correction resulting from condensation of flue gases especially at the lighter loads.

Control—Automatic or Manual

This difference in CO_2 content of the flue gases resulting from the burning of the two fuels must be taken into consideration when firing. The CO_2 resulting from complete combustion of the coal under discussion with no excess air would be 18.6 per cent or with —20 per cent excess air a CO_2 reading of 15.3 per cent. When burning the gas completely with no excess air the CO_2 reading is 12 per cent or with 10 per cent excess air, a CO_2 reading of 10.8 per cent. Varying mixtures of coal and gas give CO_2 readings varying over a wide range so that when using CO_2 readings as a firing guide it is necessary to take account of these conditions and determine whether or not the instrument being used will give correct indications on either fuel, or varying mixtures of them.

Chart

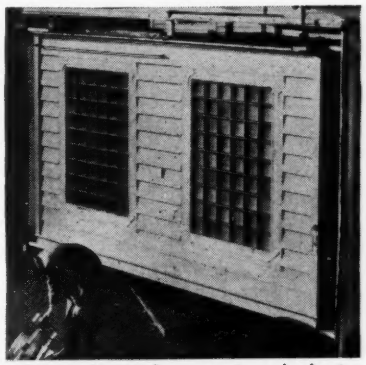
For practical operation under these conditions, a chart can be prepared from which it is possible to determine the proper CO_2 for varying mixtures of gas and coal, based on the readings obtained from a gas meter of the orifice type and from a steam-flow meter. The fireman observes the static pressure and differential pressure on the gas meter and the pounds of steam per hr. on the steam-flow meter. From these three instrument readings and the chart, the fireman can determine the proportions of gas and coal being burned and the proper CO_2 to carry for the proportions to determined. He then adjusts his air supply to obtain this CO_2 reading.

Variation in steam flow-air flow relationship caused by variation in required excess air causes difficulty when attempting to operate on automatic control based on steam flow—air flow relationships. When burning both fuels simultaneously on varying loads, it is almost necessary to operate manually; keep a close check on the actual CO_2 content of the flue gases and maintain this content at the proper value for the mixture being burned.

Solar Heat in Glass Houses

AIR CONDITIONING engineers have undertaken to solve the intricate problem of heat radiation through walls of glass block construction. The question is—how much additional cooling capacity must be provided in an air conditioning system to compensate for the solar heat transmitted through glass blocks? The Committee on Research of the American Society of Heating and Ventilating Engineers has outlined a research program utilizing a miniature house for investigation at its laboratory in Pittsburgh.

Essentially, the structure is a large heavily insulated test cubicle mounted on a turn-table so that the glass block panels may be oriented to the sun in any direction. The



Test equipment for measuring solar heat

cubicle is divided into two equal compartments by a solid partition between the identical glass block panels. There is a door in the rear of each compartment for access to instruments and the introduction of ice.

Transmission of heat through each glass panel was measured by placing ice in each compartment and then measuring the quantity of ice melted. One glass panel was shaded while the other was allowed to receive the full effect of the sun's rays. The difference between the ice meltage in the unshaded compartment and the shaded compartment gave the measure of the sun's heat transmitted by the unshaded glass block panel. In addition to the amount of ice meltage, measurements were made of intensity of sunshine before and after it had passed through the unshaded glass block panel, the temperature of the air inside and outside the compartment, the temperature of the face of the panels, wind direction, wind velocity and other attendant conditions.

Power Plant Operation Problems

In the September number Mr. Crain described a number of operating problems with their solutions that arose in the plant at Ft. Collins, Colorado. In this article he presents more such problems. They are not necessarily spectacular but they are of the type that can arise in any plant and the experience at Ft. Collins may be of benefit to others. A third and final article on this subject by Mr. Crain will appear in a subsequent issue.

By RICHARD W. CRAIN
Instructor in Mechanical Engineering
University of Washington

THE use of fuel oil in combination with coal during the time of a coal strike was discussed briefly in the first part of this article (page 65 Sept. 1940 issue).

During this test run of the oil, only barrels of oil, 50 gallons per barrel, were used. Each barrel lasted but a short time, then it was necessary to change barrels. The oil had to be heated since the oil used was a thick parafin oil congealing at 105 deg. F., and running free at 110 deg. F. If oil was to be used in this manner, there must be a larger supply and steady flow. An investigation was carried out on the proposition of installing an oil tank in the ground in the rear of the plant. This oil storage tank, to have a capacity of 12,000 gal., would be a standard tank 9 ft. in diameter, 25 ft. long, made of ¼ in. steel.

Figure 1 shows a sketch of the tank which would rest on concrete blocks in a deep pit in the ground. The pit would really be a concrete vault in the ground, and so constructed that the oil pump, oil and steam lines are accessible. Placing the tank in the vault would make it easy for inspection of the whole tank, pipe lines and pump, and the heat would be held in the tank better than if the tank were partially covered around with earth. The oil in the tank would be kept hot for immediate use, being heated by steam coils inside the tank as shown in Fig. 1. The steam passes through coils running along the very bottom of the tank from front to rear and back to front. Then up about 8 in. and through four more coils and out the front of the tank and through a steam trap. The condensate thus caught would be returned to the condenser in the plant. Oil to the burner at the boiler would run alongside the incoming steam line

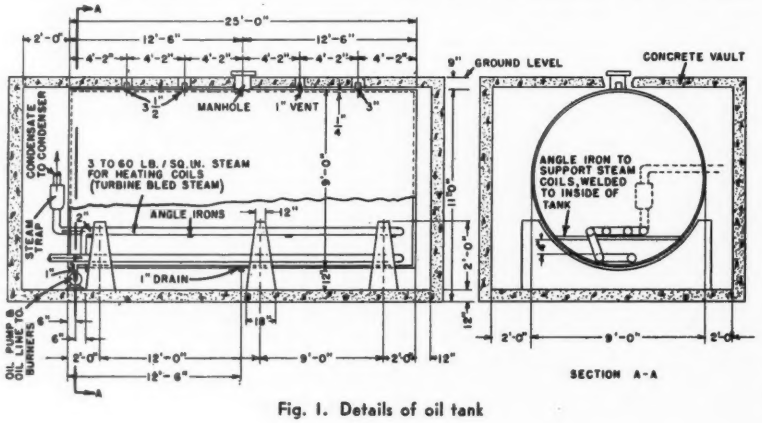


Fig. 1. Details of oil tank

and would be kept hot right to burner. The steam has to be able to raise the temperature of the oil from 30 deg. F. to 125 deg. F. Bled steam from the turbine, varying in pressure from 3 to 60 lb. per sq. in. is the steam that would be used for heating the oil.

The total weight of the tank and oil was calculated at approximately 52 t. The tank would be made of second-hand steel but made into a first class tank. The cost, exclusive of the steam coils, was in the neighborhood of $425.

The pump to be used was figured from B.t.u. values of oil and steam. It was considered sufficient to reach a capacity of 30,000 lb. of steam flow per hr. An average monthly log of the plant showed a heat value of 1500 B.t.u. per lb. of steam. The product of these two values gives 48,000,000 B.t.u.'s needed in the 30,000 lb. of steam. Dividing this by 140,000, the B.t.u. per gal. heat value of the oil, gives 343 gal. per hr., the amount of oil needed. Thus the pump must be able to pump 5.7 gal. of oil per min. However, other things must be considered. The oil would be lifted 15 ft. from tank to burner, going through some 100 ft. of pipe, and through 10 elbows. Therefore, a pump of capacity of 20 gal. per min. would have to be chosen for safety measures so that it could be depended upon at all times.

The oil used would be Bunker C oil which has this analysis:

Conradson Carbon	3.53 %
Ash	.1 %
Sulphur	None
Saybolt Furol Viscosity	60 sec. at 122° F.

An interesting sidelight is the amount of coal, that is, the equivalent of 12,000 gal. of this oil. As stated before, the heat value of the oil is 140,000 B.t.u. per gal. For the whole tank of 12,000 gal. then, there is a total of 1,680,000 B.t.u. The coal has a value of 10,000 B.t.u. per lb. Dividing these two values gives 168,000 lb. of coal as the equivalent of the 12,000 gal. of oil.

The oil burners would be placed, as shown in Fig. 2, in the four corners of the furnace, or the thickness of the furnace wall from the outside of boiler. The two front burners go out straight but toe in toward each other, and are placed 6 ft. up from the boiler room floor. The rear burners slant up about 30 deg. and toe in toward each other, and are 4 ft. above the boiler room floor.

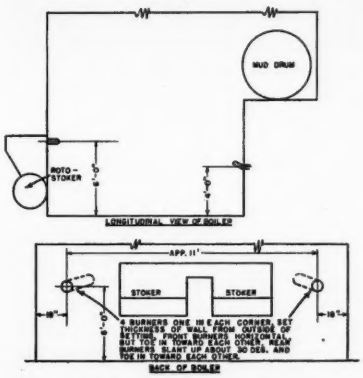


Fig. 2. Arrangement of oil burners

Purifying Lubricating Oil

Another great saving effected was in the use of turbine oil. Without some care and watching this oil, during operation of the turbine, will soon become dirty and worn out. Not here, however, for the turbine oil is watched carefully and taken care of diligently. The oil is drained from each unit after every thirty days' operation and purified by means of centrifuging. The oil is drained from the turbine bearings and oil sump and from the oil cooler into a large storage tank below the turbines in the basement. From here it is circulated through the centrifuging apparatus and by using steam and heat, the oil is rid of dirt, water, and any other foreign matter. The apparatus in operation is shown in Fig. 3.

The oil is sampled before the purifying and two or three times during the time and once immediately following the process. Upon inspection, each time the oil has shown that very little change has taken place, the report of analysis shows it to be in excellent condition and suitable for much further service. Approximately 60 gal. of oil (30 for each turbine) have been used for make-up in the two units since May 1, 1936, or an average of 1.7 gal. per month, or .0546 gal. per 24 hr. The turbine lubricating oil used it DTE Oil Light.

The circulation system is for two 1500 kw. Westinghouse Steam Turbo-Generators. They have been in service since May 1, 1936, during which time, up to May 1, 1939, the total generation was 20,974,-810 kw. hr. with a total operation time of 49,900 hr. Freedom from excessive bearing wear, the necessity of making frequent adjustments, and cleaning the circulation system have insured a reliable and continuous power schedule, low maintenance costs and long useful life of the turbo-units. The low cost of oil used is remarkable, the cost of the lubricant per 24 hr. being $0.035, and per turbine hour $0.00147.

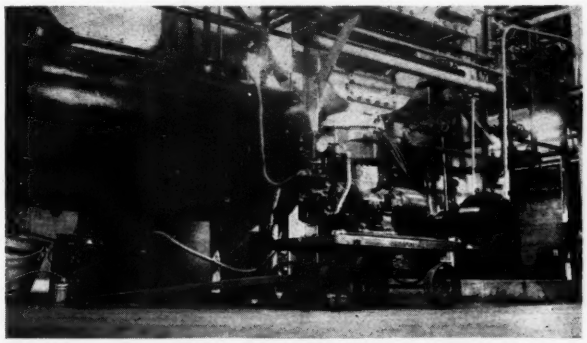


Fig. 3. View of the equipment used in purifying lubricating oil

Tests indicate that these oils are in excellent condition and entirely suitable for a much longer period of service. The condition of oil not only testifies to its suitability for this exacting service, but also to the care and attention given it by plant officials. When the neutral number in the test gets down to 0.04, the oil is no good and is replaced by new oil. It has never been necessary, as yet, to entirely replace the old oil with new.

The accompanying table of Lubrication Recommendations comes in handy at times. These are adhered to quite closely and very good results are obtained. No failures due to faulty lubrication have occurred. The turbines were torn down during the summer of 1938 for the first time and the bearing surfaces and other lubricated parts were in perfect condition, no trace of wear or scoring.

TABLE I—Lubrication Recommendations

EQUIPMENT	PARTS TO BE LUBRICATED	METHOD OF APPLICATION	RECOMMEND
All Elec. Motors	Plain Bearings	Ring Oiled	Std. Compr. Oil
	Ball Bearings	Grease Packed	2X Grease
Geared Motor (on Wt.-O-Meter)	Gear Case	Bath	Std. Compr. Oil
Stokers	Plain Bearings	Pr. Gun	2X Grease
	Ball Bearings	Pr. Gun	2X Grease
	Enclosed Gear	Pr. Gun	2X Grease
	Roller Chain	Hand Oiled	Turb. Oil Ex. Hvy.
Coal Elevator	Open Gears	Hand Greased	Cup Grease No. 3
	Plain Bearings	Grease Cups	Cup Grease No. 3
Crusher	Roller Bearings	Pr. Gun	2X Grease
Induced Draft Fans	Hydraulic Coupling	Hydraulic Med.	Turb. Oil
	Grease Seal	Grease Cups	2X Grease.
	Water Cooled Bearings	Ring Oiled	Std. Compr. Oil
Forced Draft Fans	Ball Bearings	Oil Bath	Std. Compr. Oil
Air Compressors	Cylinders and Bearings	Splash	Std. Compr. Oil
Ash Pump	Thrust Bearings	Bath	
		Ring Oiled	Std. Compr. Oil
Sump Pump	Vertical Motor		
	Ball Bearings	Oil Cups	Std. Compr. Oil
	Ball Bearings	Pr. Gun	2X Grease
Boiler Feed Pumps	Bearings and Gears	Splash	Turbine Oil Med. Hvy. No. 30
	Fast Couplings		Calumet Compound No. 7
Condensate Pumps	Bearings	Ring Oiled	Std. Compr. Oil
Circulating Water Pumps	Ball Bearings	Pr. Gun	2X Grease
	Valves	Pr. Gun	Cup Grease No. 3
House Service Pumps	Roller Bearing	Pr. Gun	2X Grease
Fountain Pump	Bearings	Ring Oiled	Std. Compr. Oil
Cooling Tower Fans	Ball Bearing	Pr. Gun	2X Grease
River Pumps	Bearings	Ring Oiled	Std. Compr. Oil
Westinghouse Turbines (2) 1500 KW.	Bearings	Circulating System	Turb. Oil Medium
Sterling Gasoline Engine	Cylinders and Bearings	Forced Feed and Splash	Iso-Vis Motor Oil SAE No. 40
Generator	Bearings	Ring Oiled	Std. Compr. Oil

ULTRASONICS AND ELASTICITY, an article by H. F. Ludloff, Westinghouse research instructor in the School of Civil Engineering, has been issued as Reprint No. 11 by the Cornell University Experiment Station. Ludloff has previously published in Europe an exact method of determining the elastic properties of solids by ultrasonic means. The present paper deals with his further studies.

Accidents in Refrigerating Plants

A NUMBER of accidents in refrigerating plants during recent months reported in The Locomotive illustrate the continual need for care in the operation and maintenance of this class of equipment. Some of these accidents were preventable but occurred either because the equipment was not properly maintained or because it was not properly operated. In one instance 5 persons were killed or injured while working on equipment under pressure. Other accidents were caused by the failure of worn parts, fatigue of metal. Too much emphasis cannot be placed on the importance of competent operation of all refrigerating equipment and on thorough inspection and careful maintenance. Following are brief descriptions of some of these accidents:

An ammonia receiver explosion last March in an Iowa cold storage plant resulted in the death of three men and injury to two others. At the time of the accident, these men were making changes in the refrigerating system. According to the newspaper accounts, and from other information that could be obtained, the ammonia was supposed to have been pumped out of the receiver before the work was started. One of the men was cutting a connected pipe line with an acetylene torch while the others were unbolting the receiver supports when the vessel suddenly burst along a welded longitudinal seam.

In attempting to determine the cause of the accident, it was found that all pipe lines connected to the tank were equipped with stop valves which had been closed. As there was no safety valve on the receiver and as the ammonia probably had not been pumped from it, heat from the acetylene torch vaporized the liquid ammonia and increased the pressure in the vessel to an amount greater than it could withstand.

A vessel that can be entirely isolated from other parts of the system by stop valves should be equipped with a relief valve, and care should be taken in changing or repairing refrigerating systems to make sure that the vessels or pipes on which the work is to be done do not contain refrigerant.

Storage Building Damaged

Another accident to an ammonia refrigerating system occurred last August in the cold-storage room of an ice manufacturing plant in Minnesota. The storage building, 50 ft. wide, 64 ft. long and 50 ft. high, was badly damaged, the roof being wrecked and one wall pushed out. Five thousand feet of 2 in. direct-expansion cooling coils fell from the ceiling, most of them being broken as they struck the floor or as they were hit by sections of the roof. Other parts of the refrigerating equipment located in separate buildings were not damaged, but approximately 1500 lb. of ammonia was lost when it was released through the broken expansion coils.

Respecting the cause of the accident, one theory was that the roof collapsed and forced out the front wall. Another explanation was that leaking ammonia vapor may have created an explosive mixture which was ignited in some way. An eye witness stated that there was a detonation, after which the roof lifted up and then caved in, indicating that an explosion had been the real cause of the damage rather than collapse of the roof.

Danger of Ammonia and Air Mixture

The disastrous consequences of an explosion of mixtures of ammonia gas and air were demonstrated by an accident last September to a large refrigerating system supplying cold storage for a midwestern packing plant. As nearly as the facts could be determined, it appears that a 6-inch elbow ruptured in the discharge pipe line from one of the compressors, thereby allowing hot ammonia gas to escape and fill the compressor room. About 20 minutes later there was an explosion, immediately followed by fire. Undoubtedly the mixture of ammonia gas and air was ignited by a spark in electrical equipment nearby. Most of the damage resulted from the fire as it burned so fiercely and with such intense heat that the overhead girders buckled, permitting the collapse of the roof and one wall. The system was a large one and as the plant operators were unable to close the valves on the ammonia suction lines, approximately 53,000 lb. of ammonia was lost. This ammonia mixing with air was the main fuel supply for the fire. The damage to the compressors was not great, although many of their fittings and attachments required replacement. A switchboard and all the ammonia, steam, brine and water piping were ruined. The total property loss was estimated at more than $75,000.

In making an investigation to determine the cause of the elbow rupturing, the plant operator stated that when he heard a clicking noise in the ammonia cylinders of one of the steam-driven compressors and observed some vibration in the connected piping, he partly closed the throttle valve. But as the noise stopped when the compressor slowed down, he reopened the throttle, thinking the trouble had been eliminated. Shortly afterward there was a strong odor of ammonia; in fact, so strong that the operator was forced to leave the building after hastily shutting off the steam supply to the compressor. Probably the clicking noise came from liquid ammonia in the compressor which withstood the strain but caused the discharge line to vibrate and rupture at an elbow.

As it was essential for plant operation that the refrigerating system be reconditioned as soon as possible, temporary welded piping was installed and a temporary building erected to house the equipment. Two and a half months later there was a second accident which, in many ways was very similar to the first one. A section of four-inch by-pass piping, connecting the suction line to the discharge line in one of the compressors, ruptured at a welded joint. Ensuing fire severely damaged the building and much of the contents although, as in the previous accident, the compressors were not greatly harmed. The probable amount of the damages was given as $20,000.

Failure in this second loss was attributed to a defective weld, as the by-pass fitting contained a comparatively small amount of fused metal in the welded seam where the rupture occurred.

The PRACTICAL ENGINEER and ELECTRICIAN

RALPH E. TURNER, EDITOR

BOTTLENECKS

In the works of a prominent steam turbine manufacturer recently, a number of rotors were noted in machines ready for completion but no workman was on the job. This factory had a large number of turbines on order that had come to a bottleneck in the stream of production due to the lack of competent machinists. Yes, there were plenty of machinists with years of experience applying and being hired to do the work but day after day these men would come to the factory, happy in the fact that they were to start work at a trade in which they were considered proficient, and a few hours later, many of these men would be found packing up their personal belongings and departing — they considered the work beyond their ability. With all industry today feverishly trying to build up the defenses of the country, the ironical truth stands out that through lack of opportunity and disuse the aggregate capacity of our skilled workman has been allowed to dwindle to a point where this shortage condition, even with numerous mechanics unemployed, is proving the principal retardant to the production of machinery and supplies desired for military defense. Power plants are in no better position in this respect than factories, it will take years to man the growing field with competent, experienced engineers who can be trusted with the care and operation of those finely machined turbines and other expensive equipment after they are installed. Mr. Pagett's article on the next page does not exaggerate the chief engineer's requirements, but industry in general has been extremely slow to recognize the need for these qualifications in the practical power plant engineer.

R. E. T.

CONTENTS

On The Human Side **88**
- Snap or no Snap. By Earl Pagett.
- Efficient Helpers. By Thomas Trail.
- Public Affairs. By James O. G. Gibbons.
- Turbine Shafts Must Run True.

Combustion of Power Plant Fuels **90**
- Natural Draft Operation of Chain Grate Stokers. By J. R. Darnell.
- Luminous Flame Firing. By G. C. Kohlar.

For The Plant Electrician **91**
- Welding as a Tool. By K. A. Pippart.
- Welding in Industry Has Become an Art as Well as a Science.
- Welding Practice. By C. O. Sandstrom.

Refrigerating Practice **93**
- Cleaning Double Pipe Ammonia Condensers. By A. G. Solomon.
- Ammonia Float Valve Troubles. By G. L. Radamaker.

A Little Education **95**

Questions and Answers **96**
- Sanitize—Or Else.
- Would Change Be Improvement?
- Gage Glass Troubles.
- Interconnecting Refrigeration Service.

Letters and Comments **100**
- Watch Engineer, Tom Extends Hand.
- Problem 7 Still Continues.
- Etymologically Speaking.

Flashed Steam Recoverable From Continuous Blow Down Systems **102**

A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE

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On The Human Side

None of the problems of the practical engineer dealing with the physical laws of nature are so divergent, elusive and changeable as are those problems he encounters on the human side, both as regards his own conduct and that of his associates. The group of articles presented here express ideas of engineers with wide experience in the field and should be helpful in formulating personnel policies.—Editor.

Snap or no Snap

By Earl Pagett

MOST YOUNG engineers envy the Chief. They see him sit at his desk figuring an intricate problem, or that he probably wears clean clothes and a white collar and tie.

If he is a good chief and an executive, most of his work will probably be delegated to capable subordinates that he has trained and on snap judgment, our young engineer will figure that the chief's job is a snap and forthwith he decides that a chief engineer he will be.

Now there are things to being chief engineer that are not apparent to the uninitiated and when every thing is weighed and considered, the chief's position may not be the snap that it seems.

A short summing up of some of the things that a chief should know and of the things that are expected of him and the burdens that he has to carry, should be interesting to those who aspire to the position, or find themselves hired or elected to such position.

To begin with, a chief must know his "math"—He must know fuels — He must know machines, water and its treatment, heat transfer, mechanics, hydraulics, piping, electricity, and what not.

He must be able to start at the coal pile, the oil tank or the gas gate and figure heat units through his plant to the condenser or cooling tower, and back through the plant again.

Whether he learns in college, or correspondence school or night school, or in actual practice, he must know how, and he must know when he is getting the maximum economy with each heat unit, that his plant is capable of, and if he is not getting it, he must be able to locate the leak.

He must balance his heat units, as accurately as a banker balances his cash and none should get away and not be accounted for. So many units at the coal pile should put so many kilowatt-hours on the switchboard, and if they do not, he must be able to put his plant in condition to do so, for if he can not he is on the spot, as the main office will be wanting to know why.

The chief must be a good financier; he must be able to figure the cost of proposed improvements and what return on the investment the improvements will pay; he must know whether the money spent for fuel would go farther if spent for different fuel; what labor saving devices will pay; what test instruments will pay; what water treatment will get the best results per dollar expended.

All these things mentioned do not begin to indicate the special knowledge that a chief engineer should have; in fact we do not know of any line of endeavor where a wide knowledge is more needed, and the chief should not only know himself, but should have the ability to impart his knowledge in the training of his help.

After all the technical qualifications are figured, there still remains the field of human relations which alone can defeat the young chief.

In the power plant, the chief is the "boss," the prosecution, the defense, the judge and the jury, yet this does not mean that he can ride rough shod over his help.

Few men react the same to discipline or orders, but every one resents a "bawling out" yet the young chief sometimes feels that this would be his right and the way to get things done.

It is the chief's duty to get the best out of his men, with as little friction as possible.

Some subordinates do their work because they *want to*. Others do theirs because they *have to* and a chief should know how to deal with both kinds but he will be in hot water if he tries to run his plant entirely with the latter kind and our new chief will find that to run his plant by force is the hard way.

The more intelligent a man is and the better he is trained the less he will need forcing and the more he resents it; a chief can easily lose the best help he has by needless bawling.

Of course, there are times when he has to be as hard as nails and make it stick, but if a man has to be continually forced and does not respond to fair treatment, it is best to discharge him and have it over with.

Another thing that our aspiring young chief cannot realize is the load of responsibility that rests on the chief; the man on a shift can go home when his shift is over and forget about his worries until the next day, but the load does not lift from the chief's shoulders when he leaves the plant. He has a continual burden from the time that he takes the job until he lays it down.

A chief must also be a diplomat. He is nearly always caught in a cross fire between his help on one side and the management on the other. If he pays too well, the management kicks and if he pays too little, the help kicks and he has a hard time adjusting things so that all parties will "stay hitched."

This is not always the case, for in some places, the management will and can rely on the judgment of the chief in every thing pertaining to the power plant.

We have heard bosses say that they do not have to get along with their help, the help has to get along with them, but a chief does have to get along with the management and it is a test of his diplomacy to draw the line between the ones that he has to get along with and the ones that have to get along with him, and do it gracefully.

While a chief engineer does not have to be a trained psychologist, a knowledge of the mental reactions and behavior of the different types will be of value, in the handling of the human element in the plant.

All of this may sound complicated to the young aspiring chief but as we have found, a chief engineer's job is complicated and chief engineers are not born such; they are made.

No man has all these qualifications to start with and they must be acquired as our engineer works his way up from the smaller less complicated plants through the medium size plants to the large complicated plants, learning all he can on each job as he progresses. After he has reached the top he will still have to work hard to stay there for power plants are not the same as they were ten years ago, or five or even three years ago.

Even the college graduate with a degree in engineering has only a good start and he will be a back number in a few years if he does not read and study continuously to keep abreast of the times.

When these things are all considered, we do not feel that the men in the high places have the "snap" that may be apparent as viewed in front of the "curtain."

Efficient Helpers

By Thomas Trail

SOME MEN and youths who are hired as helpers for mechanics do not seem to try to become efficient and thus valuable to their employer. They do their work in a more or less absent-minded manner; their thoughts often on matters far removed from the particular job on which they are working. The mechanic not only is hampered by having to remind the helper of almost every detail of his duties as they occur, but also, loses time that he might otherwise apply to his work in waiting for tools and parts that the helper should have had ready for him.

An efficient helper is a great asset for a mechanic to have. Such a helper is one who is continually alert to each of his duties in the order in which they occur. He should think ahead in order to ascertain the various needs of the mechanic. He should try to decide, or if in doubt he should ask the mechanic, what tool or part may be needed next. If he is engaged in holding a light for the mechanic, he should be alert at each time the mechanic changes the position of his view so that,

whatever part of the work on which he is engaged, the mechanic is always looking at well-illuminated work.

There is a certain amount of pleasure to be had in trying to anticipate the needs of the mechanic, since it can be considered somewhat as a game to see how often the materials or tools next needed by the mechanic will be waiting for him, and how seldom a failure occurs to have ready what next the mechanic requires.

An efficient helper, whenever he is sent away from the job for tools or materials, should not unnecessarily delay his return. He should remember that any time he may waste may cause the mechanic also to lose time that might otherwise be applied to the work. When going on a job, the helper should not leave to the mechanic the entire responsibility of remembering what tools and materials may be needed for that particular job. He should help the mechanic to visualize what may be required and in this way, help prevent or minimize the trips back from the job necessary to get articles forgotten or not anticipated to be needed.

Such efficiency in a helper is not likely to go unrewarded. It may be directly responsible for future increases in wages, or in his being kept in employment while less efficient helpers are laid off. Furthermore, such a helper is likely to be chosen for eventual mechanicship since his employers are unlikely to fail to realize that such an efficient and valuable helper is likely to become an efficient and valuable mechanic.

(Mr. Trail gives food for considerable thought in the preceding paragraphs, but we must be careful not to criticize the youths unjustly for not being mind readers. The wise mechanic will not secrete intimate knowledge of his work from his helper, if he does he cannot expect much help from the youth. They must work as a team pulling in the same direction.—Editor.)

Public Affairs

By James O. G. Gibbons

"ENGINEERS' OPPORTUNITIES in Public Life" (page 116, March issue), extracts from the speech of Mark Eisner before the Cooper Union Alumni Association should be of great interest to all engineers. It is indeed, encouraging, to find that a member of the legal profession is of the opinion that, possibly there are too many lawyers and too few engineers in public life. Although the ability to talk and express one's self forcibly, may, to some extent, explain the discrepancy, I think that there is a much more practical and significant reason why the engineer is found lagging in this direction.

As a matter of fact, practically every young lawyer hopes at some not too distant date to hang out his own shingle, and practice law in his own office. One of the most effective means of advertising himself, is to take an interest in public affairs and if possible get himself elected to office even though there may be little, or no direct remuneration attached to it.

Turbine Shafts Must Run True

When turbine rotors like the one shown here are speeded up to 3600 r.p.m. under temperatures as high as 950 deg. F. the stresses set up within the rotor are terrific, for they weigh as much as 10 tons. Yet these rotors must run true within very close limits. To devise methods which will insure safe and efficient operation of steam turbines, manufacturers have for years, engaged the services of scientists to work out a solution to this problem. In the plant of the General Electric Co., S. Homer Weaver has devised a method of "baking" permanent straightness into steam turbine shafts and rotors, for which the Charles A. Coffin award has been conferred upon him. In this process, the machine-straight shaft or rotor is suspended in a standard lathe bed. The electric oven is closed about it and controlled heat is applied through the strip heaters shown on the wall in the illustration. The rotor is turned at 2 r.p.m. and thermocouples riding on it give temperature readings. As the oven heat is raised, the rotor loses its straightness. Sliding rods passed through the wall and riding against the turning rotor indicate increasing shaft deflection as the temperature goes up. Then, at a certain critical temperature, a straightness is restored which is not affected by temperature or temperature changes. Thus the treatment is a true stabilizing cure. Mr. Weaver is shown examining a distortion-indicating rod prior to closing the oven for a heat test.

The majority of young engineers, on the other hand, have neither the desire nor the prospective opportunity to engage in independent professional practice. They have to get a job with some company, and expect to be connected with some employing company throughout their active business career. Therefore, they have to look to their employer rather than the general public, for the furtherance of their economic interests.

Those of us who have taken part in the work of groups devoted to the interests of licensed professional engineers, have found that it is very difficult to get the active cooperation of that large body of engineers who are in the employ of industrial companies. I, for one, do not blame them for, as far as I know, we have never been able to do much for them, and we cannot expect them to jeopardize their positions by becoming involved in activities which might not meet with the entire approval of their employers.

Active engagement in public affairs often requires freedom of action and control over one's own time. This is not available to many employees, and especially to the younger ones and when they reach a position where they might be able to engage in such activities they have generally lost interest.

This is a matter which, I think, should be of particular interest to your readers, the majority of whom, it is reasonable to assume, are employees, even though they may be holding executive positions. The real question is, can the young engineer afford actively to engage in public affairs, and if so, how can he go about it, without running a chance of losing his job.

Unquestionably it would greatly benefit the public, if more engineers, especially more young engineers, took an active interest in public affairs. It would be of the utmost value, if some of those, holding more important executive positions in our great industrial companies, would give this problem their personal consideration with a view to discovering some means whereby their employees, especially their technical employees, could be encouraged in this direction and afforded facilities for devoting the necessary time to activities of this kind.

Combustion of Power Plant Fuels

Natural Draft Operation of Chain Grate Stokers

By J. R. Darnell

THE OPENING paragraph of the article on "Chain Grate Stoker Operation" by A. Bement in the August issue p. 72, reads:

"Experience has demonstrated that a fire thickness at the entrance gate of natural draft chain grate stokers of 7 or 7.5 in. gives best efficiency as well as good capacity. In fact, in the use of 2 in. screenings even a thicker fire may be desirable."

The finality of such statement is startling. Mr. Bement is surprised that such thickness of fuel bed is not the prevailing practice which he finds is 5 to 3.5 in. He says he finds this is due to physical characteristics of the equipment and that the essence of the matter is one of stoker speed or travel.

Research work in the Fuels Division of the United States Bureau of Mines and later with several industrial concerns has led me to the conclusion that there are so many factors involved in the efficient operation of chain grate stokers that one should be very careful not to get out on a limb when attempting to name the most important. At one time, with a large industrial company, I had charge of a crew of 15 men for working out improvements in equipment for burning coal, oil and gas. We had 64 natural draft chain grate stokers of various sizes, burning for the most part, 1¼ to 1½ in., Illinois and Indiana screenings. Naturally, the height of the feed gate varied, depending on conditions, but I believe the average height was about 5 in. certainly not over 6 in.

Strange as it may seem, the optimum thickness of the fuel bed for most bituminous coals with forced draft is not greatly different than for natural draft if the latter is sufficient to overcome the fuel bed resistance and still be ample to carry the products of combustion through the system. Forced draft, of course, is more efficient because when such is used the damper in the uptake can be kept nearer closed and just enough draft provided to give a small negative reading above the fuel bed. This means that less excess air will be pulled into the furnace around the sides and at the end of the stoker.

Underfeed stoker operation, on the other hand, is entirely different. There, the fuel bed resistance is so great that forced draft must be employed. With chain grate stokers, since there is no agitation of the fuel bed, if the thickness is too great, even with unlimited forced draft pressure, there is a maximum burning rate beyond which the operation cannot be pushed. To do so means an actual retardation rather than acceleration of combustion. Increasing the stoker speed will not help for that would only mean dumping unburned or partially burned coal into the ash pit.

It should be kept in mind that chain grate stokers are used primarily for burning coals of high ash content having a low fusion point. Such coals cannot be agitated as vigorously as in underfeed stoker operation because the ash may fuse and cause clinker which, if it didn't jam in the links would cause a hole to form in the fuel bed and let in a large quantity of excess air.

The ash content and its fusion point and the coking or caking qualities of a coal are the chemical characteristics which must be considered in arriving at an optimum depth of fuel bed for a given boiler capacity. The physical characteristics of most importance is the uniformity of sizing. Fine material causes excessive draft loss through the fuel bed and necessitates keeping the fuel bed thickness to less than 6 in.

Coals of various districts must be handled differently and it is ridiculous to make a flat statement that the fuel bed should be 7 to 7½ in. thick. T. A. Marsh, an eminent authority on stoker operation, in his book "Combustion in the Power Plant" says that for the coals of Wyoming and Montana "fuel beds as thin as 2¾ in. to 3 in. give excellent results. To obtain good ratings such thin fuel beds must be moved at 10 to 12 in. per min., which is about double the speed used with Illinois or Indiana coal."

David Brownlie, an English author, in his book "Mechanical Stoking" recommends a fuel bed thickness of 4½ to 5 in. for chain grate stokers. From the illustrations it is apparent that natural draft stokers are referred to. Mr. Bement says that No. 2 nut and chestnut sizes of Illinois coal demand a very thick fuel bed, even up to 12 in., but must be fed very slowly. He says these sizes should be used extensively but have not been received favorably because operators fail to realize the necessity for control of stoker speed. With these sizes of coal, particularly the chestnut (1¼ by ¾ in.), a fuel bed 12 in. thick, even with the optimum moisture content of 7 to 8 per cent, would have a probable resistance of about 0.72 in. of water, assuming the so-called "straight-line" law for fuel bed resistance. This would mean that for peak loads, the stack probably would have to be 300 ft. high or over. However, even assuming that such a stack were provided, the draft in the furnace would be terrific if the loss through the fuel bed were of the order of 7/10 in. Excess air in huge quantities would be drawn into the furnace along the sides of the stoker and around the rear and stack losses would be excessive.

Most authorities agree that the maximum combustion rate for natural draft stokers, irrespective of the coal, should not be over 45 lb. per sq. ft. of effective grate area per hour and the normal rate should be from 30 to 35 lb. They also agree that the normal stoker speed or grate travel should be about 3½ to 4 in. per min. By referring to the accompanying table one can readily figure the necessary feed gate height to conform to these conditions. For example, if we assume a combustion rate of 35 lb. on a stoker 10 ft. wide and 12 ft. long, the effective grate area will be about 110 sq. ft. and the coal burned per hour will be 35x110 or 3850 lb. At a speed of 4 in. per min., according to the table, if the gate height is 5 in. we can feed 4152 lb. coal per hour. To burn only 3850 lb. the gate height should be $3850/4152 \times 5 = 4\frac{5}{8}$ in.

It should be noted that the figures in the table are based on coal of 50 lb. per cu. ft. This has been found to be an average figure for stoker sizes of bituminous coals.

The excessive furnace draft which is found with natural draft operation for heavy fuel beds is also present if only induced draft is used. In the hand book "Finding and Stopping Waste in Modern Boiler Rooms," 1928 edition p. 337, Thomas Wilson reported an operation at the Fisk St. station of the Commonwealth Edison Co., with chain grate

CHAIN GRATE STOKER OPERATION—COAL CONSUMPTION PER HOUR, GRATE SPEED ONE INCH PER MINUTE

Gate Height in Inches	Stoker Width in Feet 6	7	8	9	10	11	12
	*Pounds Coal Per Hour						
1	125	145	166	187	208	228	249
2	249	291	332	374	415	457	498
3	373	436	497	560	622	686	748
4	498	582	664	746	830	915	997
5	625	726	830	934	1038	1140	1242
6	748	872	996	1120	1242	1370	1490
7	873	1016	1162	1306	1450	1600	1740
8	998	1160	1330	1492	1660	1825	1990
9	1125	1308	1495	1680	1870	2055	2240
10	1245	1453	1660	1868	2075	2283	2490

Multiply Above Values By Actual Speed Per Min.
*Based on 50 Lb. Per Cu. Ft.

stokers burning 1¼ in. Illinois screening containing considerable duff at a rate of about 43 lb. per sq. ft. per hour. The article stated:

"With a fuel bed 10 in. thick, an uptake draft of 2¼ in. and 0.6 in. over the fire was required, and air leakage occurred, even with steel casings."

The conclusion, therefore, is that natural draft chain grate stokers are limited in their combustion rates by the permissible overfire draft and that even if forced draft traveling grate stokers are used, the combustion rate, which is determined by the combination of fuel bed thickness and grate speed, cannot be made as high as with underfeed types of stokers because of lack of agitation. This is not intended, however, in any sense, to be a comparison of the relative merits of these types of stokers as we have been considering the chain or traveling grate type of stoker only for the field of high volatile, high ash coals with low fusion point of the ash.

Luminous Flame Firing

By G. C. Kohlar

I HAVE been following the discussion of luminous flame firing in recent issues of "POWER PLANT ENGINEERING," and I feel that by this time P. J. F. must be in a very unhappy state. Mr. Vroom, who has had considerable experience with oil and gas burners in boiler furnaces, advises a non-luminous flame, whereas Mr. Kogan, who apparently has a thorough knowledge of industrial furnaces, advises a luminous flame. I should like to attempt to reconcile these divergent views.

Heat transfer by radiation is always spoken of as varying with the difference of the fourth powers of the radiating and the receiving temperatures. It should further be kept in mind that radiant heat transfer also varies directly with the Stefan, or "black body" constant. The adiabatic or theoretical flame temperature of a non-luminous gas flame is in the neighborhood of 3500 deg. F. and the receiving surface temperature in a boiler furnace would be saturation temperature, say 400 deg. F. Radiant heat transfer would then be some function of

$$(3960)^4 - (860)^4$$

These temperatures are absolute, or Fahrenheit plus 460. If the luminosity of the gas flame is increased by decreasing the excess air and thereby increasing the carbon loss, the adiabatic temperature will drop approximately 80 to 90 deg. for each per cent loss in efficiency due to unburned carbon. The difference between the fourth powers of 3960 and 3880 is about 8.5 per cent, which is a sizable decrease in radiant heat absorption. But the increased luminosity will raise the emissivity of the flame and the Stefan Constant more than enough to offset the drop in flame temperature, and we are confronted with the paradox of inferior combustion actually giving superior heat transfer.

But let us consider what happens in the boiler itself. For a given weight of fuel there is substantially the same gas weight with the luminous and the non-luminous flame. However, with the luminous flame the adiabatic temperature is lower, the absorption in the furnace is greater, which means that the temperature of the gases leaving the furnace must be considerably lower than they would have been, had the flame been non-luminous. Thus the heat transfer by convection in the boiler is materially impaired, and the overall efficiency of the unit is decreased. It should be noted that by burning more fuel with a luminous flame, the increased absorption by the furnace may make increased ratings on the boiler possible for a short time, but it is quite possible that the smoky flame will foul the convection surfaces to such an extent that in a short time the capacity of the boiler will be less than before.

Turning now to Mr. Kogan, we find that he is principally interested in industrial furnaces. In this type of furnace, convection is negligible and radiation is all important. Schack reports that a rolling-mill furnace shows the following average values of heat transfer: direct gas radiation, 54 per cent; furnace-vault radiation, 34 per cent; convection, 12 per cent. Since most industrial furnaces require a reducing flame rather than an oxidizing atmosphere, the excess air is reduced to the point where the flame becomes decidedly luminous, and even smoky. According to Schack, this procedure dropped the flame temperature from 2010 to 1830 deg., but the temperature in the furnace increased by about 175 deg. This is brought about by the fact that the unburned hydrocarbons in the gas flame increase the relative "blackness" of the flame to very close to unity. The furnace vault is unable to radiate directly to the receiving surfaces because the layer of gas between the vault and the receiving surface absorbs all the radiant heat it receives; and this gas layer, being a black body, radiates the maximum heat to the receiving surface that it is possible to transfer.

It therefore appears that both Mr. Vroom and Mr. Kogan are correct in their statements, but it is also evident that they are not talking about the same thing. Since P. J. F. is operating a boiler and not an industrial furnace, I am inclined to believe — with all due respect to Mr. Kogan — that he will get better results in the long run by following Mr. Vroom's advice to operate with a non-luminous flame.

FOR THE PLANT ELECTRICIAN

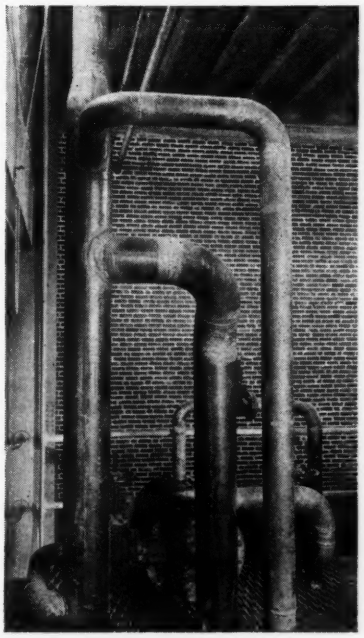
Welding as a Tool

By K. A. Pippart

IN THE August issue, there appeared an anonymous letter concerning arc welding in which the editor saw "a great deal of common sense." I should like to take issue with this "ghost writer" on several of his remarks.

He charges that the art of welding is being made a deep dark mystery and can only be administered by a witch doctor. Nothing could be farther from the truth. There is nothing mysterious about joining metal together by the metallic arc process no more so than fabricating airplane engines, building boilers, drilling and filling teeth, editing a magazine or any other of the thousand-and-one commonplace things that men do to earn their daily bread. If these things are mysterious, then welding is mysterious. A profession is only mysterious to the uninitiated.

A little further along the ghost writer makes the following statement, "The only thing that a welding operator can do is to hold the end of an electrode at a certain distance above the deposited weld metal and advance it along the seam to be welded at a certain speed. There is nothing more that is involved in this operation." This is apparently made as a statement of fact—therefore to continue this statement—the only thing that a surgeon can do is to move his knife along a certain line on the patient's abdomen and remove his appendix; or



Pipe welding advanced rapidly with the development of welding fittings

Welding in Industry Has Become an Art as Well as a Science

This view of the steel housing for a 15-ft. butterfly valve, to be used in connection with a 20,000-hp. hydraulic turbine, was taken in the Milwaukee shops of the Allis-Chalmers Mfg. Co.

again all that an editor of a newspaper can do is to move his pen over a piece of paper and he produces a newspaper. I feel certain that the "'ghost writer" would hesitate to submit to an appendectomy by such a surgeon or perhaps read his favorite newspaper prepared by such an editor—but still he would accept a welded vessel made by such a welder. Why?

During the early days of the welding industry, when it was still an infant with bare electrodes and converted d.c. motors, it became increasingly clear to the people who came in contact with welded structures, such as engineers, casualty insurance companies, state authorities, and others, that it would be unwise to permit every cross roads mechanic whose sole equipment consisted of a junked automobile engine coupled to a worn out motor to run loose over the country repairing air tanks, steam boilers, bridges, etc., by fusion welding. This naturally caused many restrictions to be placed on the industry in general.

These restrictions, however, assumed a standard nature, in that the welder must first prove his ability to produce a sound weld with a given procedure under actual working conditions. These restriction are not harsh and they do not place any hardship upon the manufacturers; instead they have had a stabilizing effect upon the industry in that they have standardized welding procedures throughout the entire industry.

In due time, the wisdom of these restrictions bore fruit to which even the "ghost writer" pays tribute when he said, "It is time we recognize that there has never been a failure on an insured pressure vessel made by the shielded arc process." If this is true there must be a good reason, that reason appears to be that most insured vessels are built under the A.S.M.E. Boiler or Unfired Pressure Vessel Code and inspected during construction by an inspector for the insurance company.

It is equally true that the files of many insurance companies contain mute evidence that a great number of improperly constructed welded vessels have failed with disastrous results, mainly because the vessel was welded by a welder who simply "moved his welding electrode at a certain distance above the deposited metal at a certain speed." It must be made clear that there are many different classes of welding. A vessel constructed under the A.S.M.E. Power Boiler Code is without question the finest vessel that can be made. But let us keep in mind all vessels are not built under this code; and that many states do not have a boiler or unfired pressure vessel code and therefore any substandard vessel can be operated in those states, regardless of how flimsy it is made.

The "ghost writer" further states that, "It is impossible, however, to make a weld on that structure which is dangerous without it being obvious to anyone looking at the weld." He apparently has never had the dubious honor of being called out of bed at 3:00 o'clock in the morning to drive 40 miles through a blinding snow storm in sub zero weather to inspect the havoc wrought by the failure of a welded joint in a steam line from which it was *impossible* to detect a dangerous condition just "by looking at the weld."

Having examined and interpreted some 30,000 X-ray films of welded joints in all types of vessels and structures, and made some 2,000 physical tests of welded specimens, I am at a loss to understand how anyone could make such a statement; for I have found by X-ray examination on numerous occasions dangerous conditions such as cracks in the weld metal just under the cover beads and extending the full length of the longitudinal seam, yet nothing was visible to the naked eye. Again on several occasions, vessels built under no code at all have ripped open through the entire length of the welded longitudinal seam under a hydrostatic test, yet no flaw in the welding was apparent "to anyone looking at the weld."

All of which points to one fact, welding when done properly under competent supervision has proven to be man's best method of joining ordinary steels; but welding in the hands of the uninformed has proven a dangerous tool.

Welding Practice

By C. O. Sandstrom

THE WRITER of the anonymous letter on welding published in the August number of P. P. E., page 75, may have been merely absent-minded; or he may have had a quaint old-fashioned aversion to having a lot of people astride his neck. But he will have the sympathy of many men who have worked in the era of riveted joints and who are now adapting themselves to this one of welds.

Probably everyone who has designed and built riveted steam boilers according to established codes, has been a bit puzzled by the restrictions placed upon welded boilers. Riveted joints of steam boilers have sometimes been assembled with liberal use of the drift pin and the calking tool, both of which produce large deformations of the material. But welded joints, to be acceptable, must be specimen tension and bend tested, radiographed, stress relieved and hammer tested in addition to the hydrostatic test demanded of all boilers. All of which implies something extremely uncertain about welded joints. If riveted joints had to meet the equivalent of these demands, they would go out of existence forthwith.

Because of the natural conservatism of mankind, new ideas are slow to take root. For many years the riveted joint was regarded the *ne plus ultra* of joints, and general acceptance of a thing so simple as the welded joint must take considerable time. It doesn't seem so very long ago that I predicted that welded steam boilers would be universal. The comment that followed seemed to imply that I was not completely assembled. Had the welded joint been the first in the field, and the riveted joint now proposed as an improvement, the assumptions for the design of the latter would be regarded as ridiculous.

In the design of a triple-riveted double-strap joint it is assumed that the shear is equally distributed among the rivets; a thing obviously untrue. Con-

sider for convenience a triple-riveted lap-joint. The middle rivet takes a certain amount of shear with a corresponding deformation. The ligament between the middle and outside rivets carries the same load in tension that the middle rivet carries in shear, and with a corresponding deformation. The deformation of the outer rivet must then be the sum of the deformations of the middle rivet and the ligament, and the shear in the outer rivet correspondingly greater. With a greater number of rivets, the proportion of the total shear in the outer one increases still more. Problems like this may have inspired the anonymous article.

I have seen a number of so-called weld failures, but in not one was the weld itself at fault. The fault was in joints that had to carry large transverse stresses that had not been considered at all in the design.

In the common method of rolling plate for shells and drums, the edges of the plate would be tangent unless mauled into circular shape. If this operation is not carefully carried out, there is a departure from a truly circular form, and if the joint is welded, will produce large transverse stresses. But if riveted with inside and outside straps in the usual manner, the joint is reinforced against transverse stresses by the straps. Thus it is seen that the double-strap riveted joint has one advantage over the welded joint. But a welded joint that is truly circular is ideal—it cannot be improved upon.

As time goes by and confidence increases, the codes governing welded joints will be modified and we probably will see expensive radiography dispensed with entirely. It was only a few years ago that welded steam boilers could not even get a hearing; so the most impatient proponent of welding must admit that some progress has been made.

Refrigerating Practice

Cleaning Double Pipe Ammonia Condensers

Practical directions for the cleaning of the inner tubes of double pipe condensers and pointers that will be of service to the operating engineer

By A. G. SOLOMON

BEFORE mechanical cleaning is begun, the water tubes of the condenser should be given a good back washing with water under high pressure if possible. After the washing is done the cleaning can be carried through as outlined below.

Close the ammonia valves, both top and bottom, and remove all the return bends at both ends. Do not neglect to remove the special water fittings and nipples between the coil and the inlet and outlet water valves. Open these valves wide, one at a time, to be sure that there is no blocking at these points. Next examine each tube by using a light at one end and looking through from the other end to determine kind of dirt or scale in the tubes.

In 75 per cent of the condensers it will be found that the top tubes have the thickest and hardest scale because the hottest gas enters the top of the condenser and the hottest water leaves there. As the tubes are examined it will be noticed that the further from the top the lighter and softer the scale or dirt becomes. Often the bottom 3 or 4 tubes need only a washing or swabbing with a stiff tight fitting wire brush. Many condensers never need or receive any other cleaning.

Four Types of Mechanical Cleaners

Of course the water may contain a great deal of scale forming sediment or the cleaning may have been neglected to such an extent that it is cheaper and better to replace the tubes with new ones. Again, there are cases where it is best to replace from one to three of the top tubes every winter. These tubes can sometimes be cleaned and replaced after heating in a fire to remove the scale. In some parts of the country double pipe condensers do not give satisfactory service and even single pipe atmospheric condensers must be cleaned almost continuously. Such condensers seldom last more than 5 yr. and in extreme cases it does not pay to use them after 3 years of service.

Many years ago we used a piece of heavy smoke stack guy wire, we pulled back and forth after making a scraping edge by cutting some of the wire strands at the center of the cable, and bending them out to enlarge that part of the cable so it would fit tight in the tube. The bent back strands of the cable pointed both ways and gave a cutting edge when the cable was pulled either way. This was hard, slow work but it did a good job if done often enough.

The first real mechanical cleaners were the stiff wire brush and the adjustable spring tube cleaner. This spring cleaner was a great favorite for many years for cleaning soot from the tubes of the common H.r.t. boiler and I have known them to be used effectively on water tubes of the Heine and B. & W. type. Both the wire brush and the spring steel cleaners were pushed through the tubes by a length of ½ in. pipe if there were room enough at the end of the condenser; if not, the pipe handle was made up of short pieces of pipe put together with couplings.

The Log Chain is Hard

In one old backwoods ice plant I saw four stands of double pipe condensers given a good cleaning by means of a long piece of log chain about 50 ft. long with two or three knots in the center. The knots did not make a real tight fit in the tube. First a piece of stiff wire was pushed through the tube and one end of the chain was fastened to it so as to pull the chain through till the knots just entered the tube end. Then a short piece of round iron, inserted in a link about 2 ft. from the tube ends, was used to twist the chain till it fit tight in the tube. By keeping the chain twisted tight and working it back and forth a good job of cleaning was done even though the scale was thick and hard. Two stands of the condenser were cleaned every Sunday and while it was as hard a job of condenser cleaning as I ever saw, the condenser had been in service 12 yr. with never a leak in a tube.

But the New Type Was Easy

Next the engineers were given the chance of having clean condenser tubes with no real hard work. Mechanical boiler tube cleaners of the rotary type had been in use for some years before one of the manufacturers put small size cleaners on the market to fit any size pipe or tube from 1 in. up. Now they are made smaller and can be had to fit the small size copper tubes used in condensers or brine and water coolers of small capacity air conditioning units. The demand for the cleaners for 1¼ in. pipe was a happy surprise to the manufacturers. Either air or water operated cleaners with sets of saw teeth cutters that hugged the tube surface as they were forced outward by centrifugal action gave perfect cleaning.

There was also a drill head that was like a reamer and could be attached to the revolving head and acted like a drill in badly scaled tubes. With this rotary cleaner it was possible to clean the tube right down to the iron, in fact the man using this high speed rotary cleaner had to keep it moving back and forth continuously for if left in one spot long enough it cut into the tube and caused a leak.

Home Made Tools More Difficult

Some engineers used a regular air drill motor or electric drill motor to drive a twist drill, fastened to a length of ½ in. pipe and of a size to enter the tube snugly and remove all the scale as it was forced through. It did a good clean job on hard scale but it was very hard to handle.

Every return bend should be examined and cleaned of scale if necessary. Close inspection of the return bends

is particularly necessary in plants where the water is handled by plunger type pumps with rubber valves and canvas hydraulic plunger packing and valve studs and brass springs. Small pieces of valves, packing and broken studs and springs will often lodge in the return bends and cut down on the water supply.

Air Cleaning

In places where the sediment contained in the water is more sludge or sand than scale forming, the use of an air blast will be found valuable as a cleaning agent. Shut the water off top and bottom and remove the plugs from the tees that should be found between the water valves and the condenser. Connect the air hose to the top tee by using a nipple, valve and union and turn on the air at the highest pressure available. When the water has all been blown from the coil and the air is coming freely, shut the valve at the air hose and open the top water valve and leave it open till water flows from the opening of the bottom tee. Then blow with air again. This will loosen and wash out any sediment that is not baked in the tube as scale. There are many plants where this method of using the air blast cleaning is done every day and it has proved its worth. In some plants the two top tubes are replaced every year with new ones as it is impossible to remove all the hard scale.

Chemicals

I have seen kerosene, engine oil and fuel oil used for softening and removing scale but I never saw any real success with this treatment. There are chemical companies that put out different chemicals for removing hard scale. Such chemicals are pumped through the coils by a small pump a great many times in 5 or 10 min. The coil is then washed with water. In most cases the return bends should then be removed for final cleaning and inspection.

Attempts are often made to clean condensers of all types by freezing and heating to loosen the scale and in one case I witnessed a remarkable success. It was an atmospheric single pipe condenser having 60 stands 20 ft. long made up of 2-in. pipe, 12 pipe high. The pipe was originally galvanized on the outside but the galvanizing had been knocked off from the many cleanings during years of service. This condenser was equipped with a pump out header extending across all the coils and connecting to the top of each coil with a ½-in. valve. This header was also used as a purge header and at one end was connected into a purge tank 12 in. in diameter and 3 ft. long. The other end of the header extended down to the engine room where it connected into the suction line of two compressors.

The chief engineer selected one heavily scaled stand and shut off the 2-in. top gas inlet valve and the ½-in. bottom liquid outlet valve. Next he shut off all the ½-in. purge or pump out valves and the ½-in. valve to the purge tank. He then opened the purge valve wide on the coil to be cleaned before going down in the engine room to open the ½-in. valve connecting the pump out line with one compressor. After the coil was pumped out he went back to the condenser tower and proceeded to regulate the ½-in. liquid outlet valve as if it were an expansion valve. It was cool weather and with a good charge of ammonia in the system it did not take long to frost the coil. After frost showed up on the pump out line, he spent about an hour watching the compressor and gages in the engine room and the one coil of the condenser to see that it stayed nicely frosted.

The ½-in. valves on the coil were closed and the 2-in. hot gas valve was opened wide. This started a rapid cracking sound as the tube expanded and cracked the cold scale. The water had been shut off that coil and also the next one on either side of it. The engineer did not pay any attention to the 6 in. of water in the condenser pan but went right in between the coils and helped crack scale with a light hammer. At the end of 10 min. there was none left on that coil. The coil was now turned back into service. The next morning the engineer and one helper began cleaning the condensers at a rate of from 6 to 10 stands per day and the job was all done, including the condenser pan, in less than 3 wk.

Ammonia Float Valve Troubles

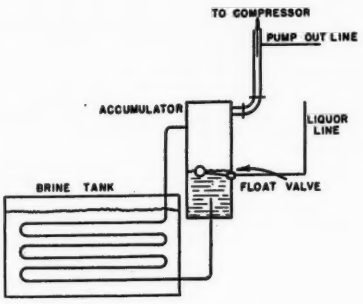
By G. L. Radamaker

IN EVERY PLANT, troubles with machinery and extraordinary operating experiences all contribute to the operators engineering knowledge. The following experience, I hope will show the unreliable nature of float valves used in an ammonia system, and the advantage of false head ammonia compressors for safety. A section of the refrigerating plant was laid out approximately as shown in the diagram with the brine tank used to freeze ice cream in molds, which in turn were made into chocolate ice cream bars.

The engineer when making his rounds noticed the brine tank temperature was higher than the normal of 20 deg. F. below zero. Upon returning to the engine room to check his gages he found that the ammonia receiver was normal at 125 lb. pressure, and a vacuum equivalent to 25 in. of mercury on the suction side of the compressor. Since the normal operating temperature of the brine tank was minus 20 deg. F. this suction pressure was low enough, even though the ammonia gas returned to the machine slightly superheated. Very unlikely since this is a flooded system with an accumulator.

After checking the valves and finding these in correct positions the engineer decided to pump out the ammonia coils in the brine tank, thinking the trouble was probably in the float valve, that it was stuck shut and that pumping out the system would break it loose. Pumping out the ammonia coils and accumulator in the brine tank would ordinarily take about an hour or less, but this time it took almost 16 hr. (note connection of pump out line), it is easy to understand why the engineer was in a quandary—or whatever it is that engineers get into when they can't find the source of trouble.

After the system was thoroughly pumped out it was decided to remove the elbow from the suction line immediately after the accumulator. When this was done it was found that the stem to the float valve had broken. The accumulator had entirely filled with liquid ammonia and carried the ball float up with it into the suction line had wedged it in so tightly that it was impossible to remove the float without breaking. It is easy to understand why it was wedged in so tightly when it



Broken float stem gave trouble

is remembered that the accumulator had a pressure of 125 lb. and the suction line to the compressor had a vacuum of 25 in. of mercury.

This experience shows one instance where the engineer can not rely entirely on float valves and automatic machinery. Besides the failure of the float valve by the stem breaking, as above, it has been found that float valves are prone to stick especially when a little oil gets under the seat at low temperatures.

If the above plant had been equipped with horizontal ammonia compressors or with compressors without a false head for safety, the results may have been more disastrous when the ammonia liquor began to carry over into the suction line, probably resulting in knocking the head out of the compressor.

* * *

A new cement with finely divided particles of copper incorporated with caustic magnesia, when mixed with a solution of magnesium chloride, shows good resistance to weathering and is said to be particularly applicable to composition floors, stucco, and mortar for interior tile work and glass brick. Its strength is several times that of portland cement but its cost is high.

A Little Education

FOLLOWING publication of the article, A Little Education, on page 70 of the June issue, a large number of letters were received from engineers, ex-students, prospective students and practically all the universities. Most of these were highly complimentary and several asked permission to reprint all or a portion of it, which is of course, gratifying to us. A few were slightly critical.

We regret that due to the large number received and to limited space we can do no more than present a brief concensus of opinion and short abstracts from several letters. There is no question but that correspondence study requires: first, a definite interest in a given subject; and second, a great deal of perseverance. The majority, however, feel that this perseverance is rewarded, not only by what is learned about the subject in hand, but by training in planning and following a directed course of study rather than haphazard reading.

"It is our opinion," writes Dorothy Beem of the Department of Correspondence Instruction, University of California, "that in many cases correspondence study is actually preferable to other methods of study in that each student is entirely on his own and must thoroughly understand each phase of the material before he is able to progress to the more advanced sections. Contrary to the opinion of many, correspondence study is not mechanized but is even more easily adaptable to individual needs than many a class room course."

This point of individual instruction is stressed by a great many, one educator, Dean Thompson of the University of Chicago, going so far as to say that, "We feel more individual attention is given by correspondence study methods than in 90 per cent of campus classes."

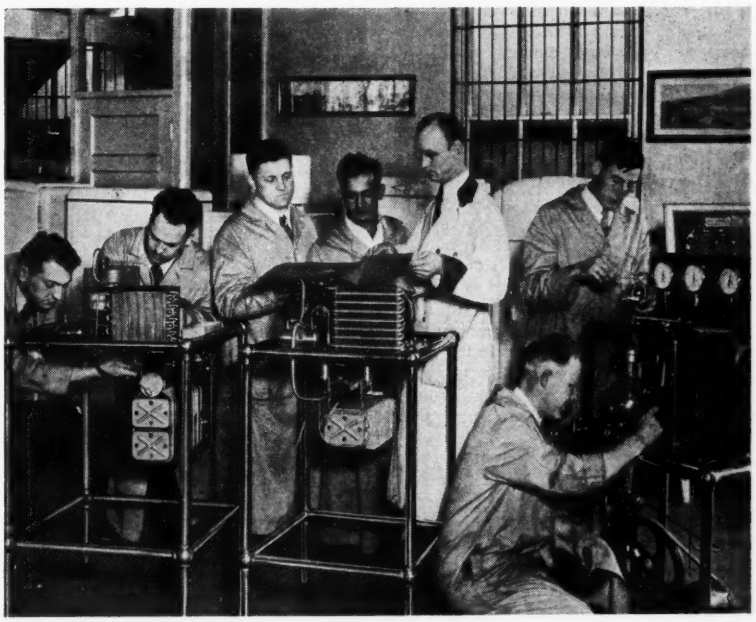
Class Instruction Desirable

Nevertheless, the feeling is general that regular class instruction is desirable where possible because of the personal relationship of teacher and students, association with others of the same age group and interests and a wider sphere of influence. It is, of course, foolish to say that a college or even high school is a necessity for success in any line of work, for the number of successful men who lack any considerable amount of formal education disproves the statement.

Nevertheless, successful individuals must acquire their education somewhere and regular schools have the advantage of giving a more complete educational background, more adaptable to any condition that may arise. Dean Thompson's remarks below on the present industrial attitude toward practical training and an "inverted" education are particularly interesting.

While some colleges allow a limited amount of correspondence study toward a degree, the practice is frowned upon by the majority. All agree that from a practical standpoint, fundamentals can be taught to advantage by correspondence but some educators do not approve of the so-called vocational courses. Nevertheless, the success of these courses by a number of institutions indicates that the fault lies primarily in the quality of the course and instruction.

In certain industrial districts, particularly when the cooperation of industrial companies can be obtained, good work has been done along this line, although it must be admitted that in these cases it is usually possible to arrange class instruction.



Throughout the country are many trade schools that finish their courses by assembling students in laboratories like this one of the Refrigeration and Air Conditioning Institute

Determine Capacity of Student

C. G. Gaum, Head of the Bureau of Correspondence Study, University Extension Division, Rutgers University, writes in part:

"In conclusion, I could have wished that a little more emphasis might have been placed on the efforts of all the state universities and colleges to determine the capacity of the prospective student to profit from a course which has attracted him, and also to assist him in formulating a longer-term program of study."

Dean Thompson comments on the opinion made by many employers that an education, particularly a college education, is not necessary. This is, of course, reflected in the attitude of parents and children, and he expresses the wish that the article might be reprinted and placed in the hands of every high school principal and student to help them appreciate what extension work can do for them as a continuation of so-called "practical" courses which increase the immediate prospect of a job but offer little in the way of future advancement. In connection with the section Fundamentals First in Column 3 on page 72 of the June issue, he says:

"As you are aware, we in academic circles have argued for a long time that it is wise to have the fundamentals first which usually means approaching courses according to subject matter logic. This procedure takes considerable time and our experience leads us to feel that, although some claim that few jobs are open, many vigorous youngsters are finding jobs although they do not have the college education first.

"They are taking 'practical' courses sometimes as a background for a job, but they are going into jobs. Realizing that the fundamentals will be essential if later promotions are to come, or if their present jobs are not to end in blind alleys, we are coming to a realization that through university extension divisions, opportunities must be provided for these people to consider the fundamentals after they are at work.

"This is somewhat of a reversal of the subject matter logic approach. They are entitled to a basic general education and if they cannot get it before they begin work, they must be provided with the opportunity to secure it afterwards."

Greater Opportunities Opened

Most comprehensive of all were the comments of James A. Moyer, State Director of University Extension in Massachusetts, a well known engineer and author of many engineering books. He says:

"These courses in different branches of engineering—civil, mechanical, electrical and practical aviation—have given, and are giving every year to workers, greater opportunities to obtain more special knowledge of the work in which they are engaged. As a result, the workers become more proficient in their jobs, and in many cases have earned advancement.

"With the demand for technically

trained workmen greater than ever, owing to the proposed preparedness program, such courses as these will become even more and more helpful in the industrial world.

"Workers in power and industrial plants who are profiting by these home study courses are both old and young; experienced and inexperienced. Many skilled workmen, foremen, and supervisors—all practical men with years of experience behind them — know but a smattering of mathematics, a bit of physics and drawing, and very little theory. These men welcome the chance home-study courses offer them to make up their lack of formal engineering education.

"The young untrained worker in these plants who, by 'getting a job,' has reached the first round of the ladder leading to industrial success, often finds himself practically stopped right there. He finds it increasingly difficult to become well versed in the efficient operation of power plants or in the better production methods of the finished article his plant is making because, through mass production of power or manufactured articles, he performs only a small part in its production.

"He is given little opportunity to anticipate and prepare for the requirements of the job above his. The next rung of the ladder is much too high for him to reach unless he can obtain outside aid. To such a young fellow, provided he is ambitious and willing to put in long evening hours of home study, home study courses offer a real hope.

"Naturally, some workers, located in large cities which are educational centers, can and do attend evening technical schools or university extension classes; but there are many, many others who are dependent upon home study courses for their continued education. They make up two groups: one which lives and works in small manufacturing cities or towns, too far away from those centers where University Extension classes are held or where night schools are located; the other group, which, regardless of residence, prefers individual home study work to class instruction.

"Members of this second group may want to do intensive and rapid work by themselves. They do not care to be hampered by slower-thinking members of a class, or retarded by slower-working ones. They appreciate receiving the understanding criticism and the personal undivided attention of the instructor that is a component part of correspondence work.

"But the industrial workman is not the only one who finds home study courses helpful. The practicing engineer with technical college training and years of practical experience behind him, often enrolls in these courses. Perhaps he feels that he is becoming a bit rusty on certain fundamentals of his profession and wishes to brush up on them, or perhaps he has not paid enough attention to the many advancements being made yearly in the sciences, and wishes to catch up with new ideas and methods.

"Of course, he could remedy all this by doing each day a certain amount of reading, technical magazines and the latest technical books, but too often he finds it difficult to bind himself to such a purpose. There is nothing tangible to hold him to it, and the 'certain amount' of reading is apt to become a spasmodic effort rather than a habit.

"Therefore he enrolls in a home study course, practically pledging himself to study so much each week. As a result, before many months have passed, he discovers that he has entirely overcome any possibility of stagnation, has refreshed his memory on many forgotten details, and has become familiar once again with the latest professional trends and methods."

Questions And Answers

Sanitize—Or Else

PROGRESSIVE legislation by the state of New Hampshire has provided me, over an extended period, with interesting problems, many aggravations, and a tremendous amount of work.

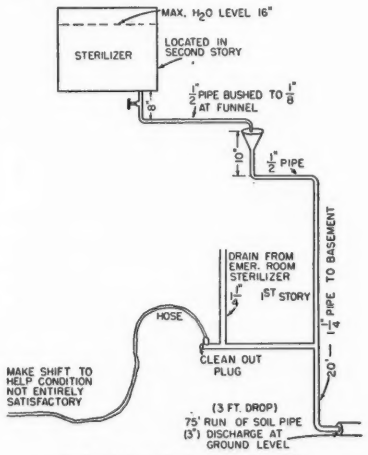
When the accustomed serenity of the day was interrupted by a gentleman who announced himself as a state inspector from the board of health I had small inkling of the misery in store. In a short half hour he laid out spare time work for all winter. Every flushometer had to be equipped with a vacuum breaker—every overhead flush tank so piped as to eliminate an under water supply discharge—all bed pan hoppers and washers repiped or piping eliminated to afford the same protection—and that wasn't all. I had to devise or invent some means of feeding and discharging each of the sterilizers in sterilizing and emergency rooms. By this time I was in no mood to be impressed by the gentleman's official position and inquired sarcastically about the possibility of the blow down tank back siphoning through the safety valve.

"All this," I said, "is going to cost us a lot of money and make me a lot of work which I can find no time to do. What's going to happen if I invite you to go jump into the brine tank?" "Just that the state wouldn't renew your license," was his reply. So it seems that the legislation had plenty of teeth and we got busy.

It took some time to find out where we could buy the vacuum breakers and devices for sterilizer protection. The equipment which we eventually found ourselves able to buy was so much more in keeping with the shining batteries of stills, tanks and sterilizers that it was decided to buy rather than to make up something out of pipe fittings.

We had arguments with supply houses from Boston to Chicago before finally assembling breakers, fittings and adapters so that we could go ahead and install the breakers. These are very simple and efficient and consist of two pivoted plates one of which closes a port to atmosphere at all times except at a period of vacuum in the supply line when the reverse current of water, acting on the plate in its path unseats the other plate and opens the breaker to atmosphere.

Overhead flush tanks, I protected by cutting off the supply discharge tail pipe above the water line. There is a certain amount of noise from splashing but it disturbs no one. It was found practical to do away entirely with urinal flushes as provided in the original equipment. It was a simple matter of rearrangement to change the water supply of X-Ray development tanks from under water to overhead discharge.



Soil piping that gives trouble

In the sterilizing room I have a problem for which I have as yet no satisfactory solution. It was required by the new regulations that the drains have air breaks. This meant that the drains had to be cut and drip funnels inserted. Not long after the change a peeved nurse called up for a boat. For some obscure reason those funnels were filling and running over on to the floor. I cut the drain down to ⅛ in. and still there was trouble. The funnels have a ½-in. outlet draining through a short length of pipe of the same size into 1¼-in. risers, thence into 3-in. soil pipe with an independent discharge in the

grove some 75 ft. from the building. No other drain is piped into it except provision for blowing the filters when washing them. I have thought of no satisfactory method of correction but have made it possible to operate by connecting a hose to fittings in the basement inserted at the point where the clean out plug is located. It would seem that the trouble is caused by air binding but I can see no way to correct the trouble. I expect some one may have a good idea. May I hear it? Thank you.

A. H. PARKER.

Would Change Be Improvement?

IN REFERENCE to E. G. D.'s problem of the gas fired boiler presented in the August issue, page 77, my opinion is that, to move the bridge wall back to the rear of the boiler to make an open fire box should improve combustion, but I would not build it up square as it is now. This would tend to form a narrow throat where the gases pass up to the tubes. I would start back about two feet from the rear of the combustion space and pyramid the bridge wall up to practically nothing, having the top near the height of the present bridge wall. This would tend to scoop the gases up and give them a turbulent action, thereby sending them into the tubes with less resistance.

Baltimore, Md. CHAS. W. PARKS.

Gage Glass Troubles

NATURALLY, "Gage Glass Troubles" on page 80 of the August issue caught our eye by reason of its being "up our alley." The correspondent's comment on his troubles is typical, it could have originated from any one of thousands of operating men. Your response was very well phrased, we couldn't have improved on it, which you'll admit is quite a concession for any expert to make an editor!

All of which brings us to a point which is too often overlooked by engineers and editors alike. Every time a tubular glass breaks, bursts, blows-out or explodes (take your pick) someone is in danger of bodily harm. Therefore said glass constitutes a physical hazard—the proof of which can be testified to by a few thousand boiler operators who have actually felt the flying glass at some time or other during their careers. And the only reason tubular glasses are tolerated by otherwise good engineers is simply that they are mired in the rut of tradition.

Since organized safety has gained a real place in industry, tubular glasses have been eliminated to some extent in large plants. Companies like Ford, Du Pont, U. S. Steel, etc., who have safety engineers to compare the dollar value of an eye accident with the slight expense of gage glass protection, won't tolerate a tubular glass in a hazardous application. And if it's good business for the big fellows, it's ditto for the small plants, when protection is a matter of 15 or 20 dollars.

For the last several years, the company with which I am connected has waged a "one man" campaign to eliminate tubular glasses. "Safety in gage glasses" is stressed and Prismatic type glass is strongly advocated. The Prismatic is a low cost insert. It's not new in principle and a great many thousands are in use in every type of industry in the country. The glass is heat treated so that in the remote event of breakage the fragments interlock and remain in the housing.

Cleveland, O. G. E. SAMS.
The Reliance Gauge Column Co.

* * *

THERE IS very little doubt in my mind but that the gage glass trouble of A. H. P. (August Issue, page 80), is due to the connections being out of line as I have had several gages break due to this cause. The method that I use to make sure that the connections are in line is to see that the glass tube is perfectly free to move up and down and to turn easily without rubbing any side more than another before tightening the nuts. If the pipe connections to the boiler are rather long and are not solid enough or well supported there may be enough movement here due to expansion to throw the nuts out of line.

As to the life of a gage glass tube you seem to think that 6 mo. is well enough. I have no statistics but my impression is that the life is much longer, probably 3 yr. as an average for the cases of my experience. At the plant where I work now there are 4 boilers, 140 lb., operating 24 hr. and blown each 8 hr. In the 3 yr. I have been here, we have lost five gage glass tubes which will give an average of slightly less than 3 yr. per gage glass. On the basis of my 15 yr. experience in other plants, although I do not have any actual figures, my impression is that the life of gage glass tubes is longer than 3 yr.

Oak Park, Ill. N. T. PEF.

* * *

TUBULAR gage glass service life is influenced by many factors, some of which are not generally known or recognized. There are, in fact, so many such factors that it is not always easy to account for some of the wide variations in reported service life under apparently identical operating conditions.

Assuming that the gage glass has been properly installed with a minimum of strain, the factors discussed below then come into play. (No attempt has been made to list these in the order of their relative importance.)

1. STEAM TEMPERATURE—The rate of attack on glass by condensing steam varies directly with temperature. Also, higher steam temperatures establish greater thermal gradients between steam and air outside of gage, thus increasing rate of condensation with consequent increase in solvent action on the gage glass.

2. STEAM PRESSURE—Aside from the effect of pressure on condensing temperature, it becomes increasingly important during the latter stages of gage glass life when the glass tube .wall has thinned-down from corrosion, and then becomes too weak to withstand the pressure.

3. RATE OF CONDENSATION IN GAGE—This is perhaps the most important single factor affecting gage glass service life. In general, it can be safely stated that every drop of hot condensate which trickles down the side of a glass is equivalent to "driving another nail in the coffin." Obviously, anything which increases rate of condensation shortens the service life. Locating the gage in a windy, draughty, or relatively cool location would have such effect.

4. DRIFT OR SLOPE OF STEAM PIPING TO GAGE—Unless the condensate in the inlet steam piping to the gage can flow back to the boiler directly, it must necessarily trickle down the gage glass, thus causing unnecessary damage by its solvent action on the glass.

5. GAGE DESIGN—Gage design which permits condensate droplets to fall free through the glass tube without touching the sides is beneficial.

6. BOILER WATER COMPOSITION — As every power plant operator knows, most gage glasses fail first at the steam end. In all but extreme cases, therefore, boiler water composition is a less important factor than condensation, but the comments which follow are pertinent.

7. BOLIER WATER PH, OR ALKALINITY—The rate at which boiler water attacks glass is governed almost entirely by temperature and pH, assuming complete absence of fluorine compounds. Current boiler practice, using water of rather high alkalinity, and pH of 10.0 or more has increased the rate of attack on the water end of gage glasses.

8. MOVEMENT OF WATER IN GAGE—In general, the less the water moves in the gage glass, the slower the glass will be attacked, because under quiescent conditions, a film of corrosion products forms on the surface of the glass and exerts a protective effect. Actually, the composition of the water in the gage is constantly changing because of the continuous addition of condensed, distilled water. For the same reason there is a continuous flow of water through the gage back to the boiler. But most detrimental is rapid fluctuation or oscillation of liquid level because this washes away the protective film and accelerates corrosive attack by the alkalies present in the water. In some instances excessive vibration of the gage is believed to result in similar washing away of the protective film.

9. THERMAL SHOCK — Gage glasses are, of course, subjected to rather abrupt temperature changes during the periodic blowdown period. And since glass is a relatively poor conductor of heat it does not quickly become uniformly hot or cold throughout following exposure to such temperature changes. Consequently, unequal expansion causes the inside or hot surface of the tube to get "too big for its britches," and this creates internal strain in the glass. For this reason, the less the glass expands or contracts with temperature, the less is the internal strain resulting from such thermal shock. Glasses having low coefficients of thermal expansion are thus able to withstand such treatment without rupturing. It should be

borne in mind that strains introduced thermally in the glass are additional to those resulting from steam pressure or poor alinement, etc.

10. GLASS COMPOSITION—It is generally recognized that most glassware has marked resistance to attack by acids. There is, however, much wider variation in the ability of various glass compositions to withstand alkaline attack in the pH range encountered in gage glass service. But years of extensive research have made commercially available, glass compositions incorporating improved alkaline resistance along with ample mechanical strength and low thermal expansion. Research still continues on glass composition, and there is reason to believe that continued improvement can be expected.

In view of the large number of variables discussed above, it is obviously difficult to predict the service life to be expected from tubular gage glasses. Nevertheless, POWER PLANT ENGINEERING would be rendering a real service to gage glass users and manufacturers by acting as a collecting station for actual field performance data, as suggested in the August issue.

Corning, N. Y. T. J. THOMPSON.
Manager, Industrial Division
Corning Glass Works.

Interconnecting Refrigeration Service

IN AUGUST, 1940, issue of POWER PLANT ENGINEERING, L. S. submits a question to which the following is a reply:

The creamery condenser was doubtless designed to handle operation of 7½ by 7½ in. compressor at full capacity and a discharge line is not required. An ammonia suction line of sufficient size to minimize pressure drop should be installed together with a small ammonia liquid line. The latter should be connected to the receiver of meat locker plant so all available storage can be used to handle any surplus liquid ammonia.

A knowledge of the heat load, speed of compressor and other essential data, would be required to figure pipe sizes and determine if the 7½ by 7½ in. compressor will handle the entire load including losses in the additional piping. The 600 ft. of suction line will probably have to be insulated to prevent excessive heat loss and the cost of installing, supporting and protecting the new piping is likely to be considerable. In the writer's opinion, L. S. may find it less expensive, and certainly far more desirable and advantageous from an operating standpoint, to install a spare 6 by 6 in. compressor in the meat locker plant for emergency service.

Fresno, Calif. E. H. CARLSON.

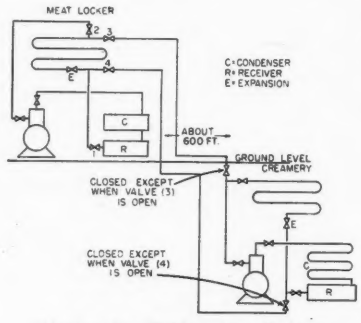
* * *

REGARDING the inquiry of L. S. out west as to the best method of interconnecting a meat locker plant and a creamery, which is about 600 ft. away, I believe the simplest, least expensive and most flexible way of making the connection would be to use a suction gas line running from the meat locker coils to the creamery compressor, using the creamery condenser and receiver also. A small liquid line should be run from the creamery receiver to the expansion coils of the meat locker. This hookup will permit the compressor of the creamery to be used on the meat locker in case of a breakdown of the meat locker compressor and will also permit the compressor of the meat locker to be used on the creamery in case of a breakdown of that compressor.

The condenser for the creamery was most likely designed to handle the gas from the creamery system only, so it probably will be necessary to circulate more water or cooler water if possible.

It was also stated that the receiver in the creamery is only large enough for the coolers there. This should make no difference when operating the meat locker coils on the creamery compressor, condenser and receiver because the ammonia will be circulating in the system.

The accompanying sketch will show the hookup of the two systems. In case the meat locker compressor broke down liquid valve (1) would be shut off, then the suction valve (2) this would take the coils off the meat locker system. As soon as possible open up suction valve (3) and liquid valve (4) to put the meat locker on the creamery system.



Hookup For Refrigerating Systems

To change meat cooler coils over to the creamery compressor, close liquid valve (1) and suction valve (2) and then open suction valve (3) and liquid valve (4).

If more liquid is needed after meat cooler is on creamery system close valve (4) and open valve (1) until the required amount is obtained, then close valve (1) and open valve (4).

After being back in normal operation, to get the liquid out of the creamery receiver back into the meat receiver if some had been taken out, close valve (1) open valve (4), suction valve (3) has already been closed and suction valve (2) opened, when the required amount has been drawn out of the creamery receiver valve (4) is then closed and valve (1) opened.

In answering a problem of this kind it would be helpful to know if the creamery compressor is intermittent in operation or if the speed can be changed, it also would be helpful to know if hand expansion valves are being used or if some type of automatic. With this information a more detailed drawing and explanation could be given. A more detailed sketch could also be made showing how the suction and discharge lines for the meat locker compressor can be pumped out, but I think this drawing will convey the idea of the piping hookup and that changes could be made to suit the inquirer's convenience and purse.

The suction pressure in the meat cooler coils will be slightly higher than in the creamery coils even though they have a common suction at the compressor, this is due to pipe friction, elbows and connections in the 600 ft. from the meat locker to the creamery.

If for any reason, after both systems have been operating on the creamery compressor, condenser and receiver, more ammonia is needed in the meat locker coils and the receiver for the creamery does not contain enough to supply it, ammonia can then be taken out of the receiver in the meat locker room by the manipulation of the proper valves explained under the drawing.

To put meat cooler coils back on meat cooler compressor close valve (4) and suction valve (3) then open suction valve (2) and liquid valve (1). To get liquid out of creamery receiver back into meat receiver if some had been taken out, is explained under the drawing.

In running the pipe from the meat locker to the creamery, I would not run the pipe above ground because of the cost of pipe hangers or supports and the effects of the weather. I would advise digging a trench that can be well drained, hollow pipe or drainage tile should be used. From the problem drawing this drainage can be accomplished very easily because the creamery is below the level of the meat locker so with the proper slope to the trench it can be made to drain into the sewer of the creamery. The amount of insulation to be used on the pipe would depend upon the climatic conditions.

Fort Thomas, Ky. WALTER H. HARVEY.

* * *

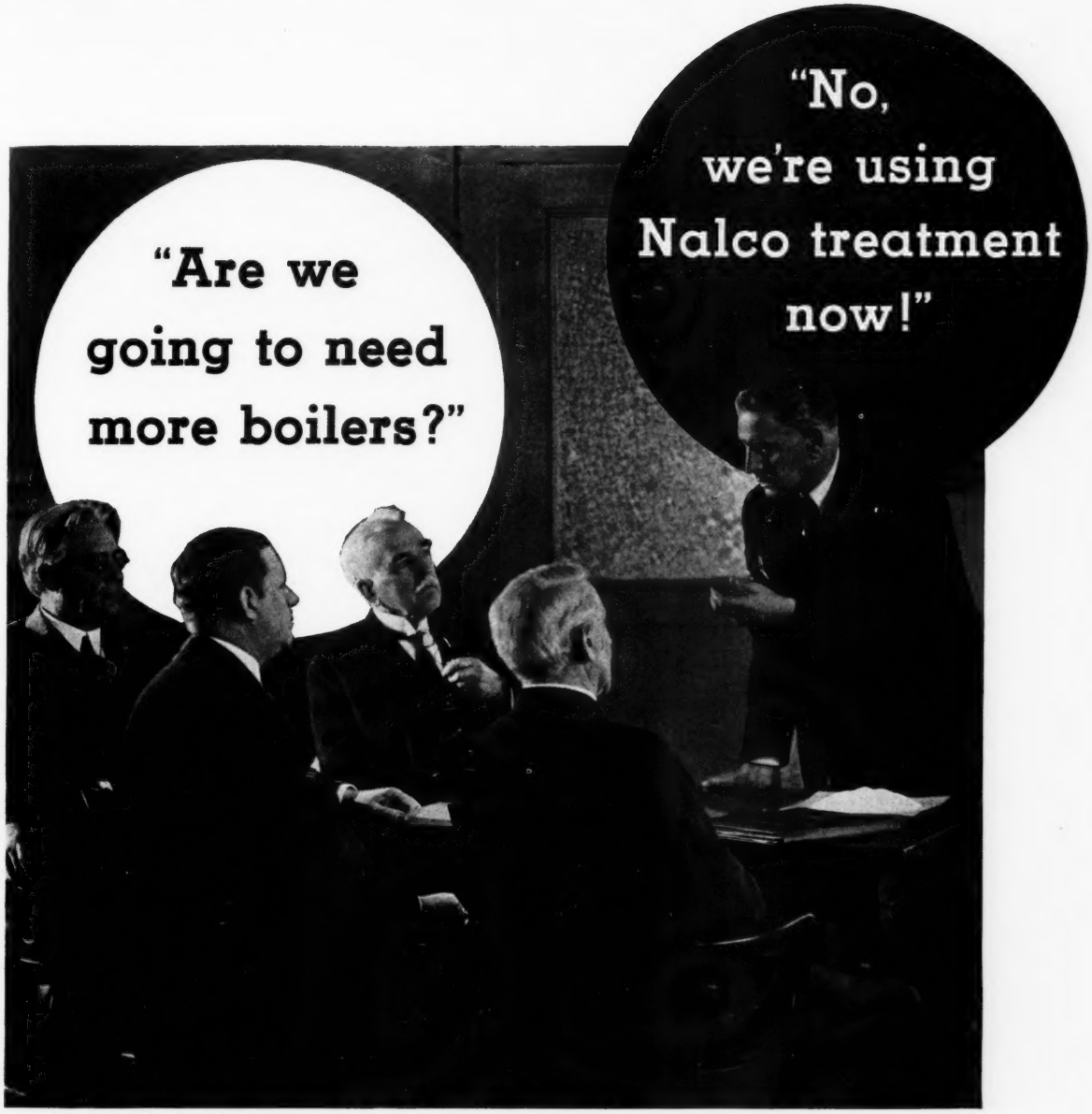
A patented ice table has an 8 ft. large oval metal surface finished in chromium with refrigerating pipes on top, surrounded by a metal rim about 2 in. high. This space fills with the condensation from the air and forms a sheet of ice which becomes the table top.

* * *

Idlers or tighteners used on belts should be applied to the slack side near the smaller pulley so as to increase the arc of contact and reduce slipping.

* * *

Some years ago it was practically taken for granted that a certain amount of commutator seasoning would take place in the field during the first year of operation and that commutators should be tightened periodically as the mica baked out. Factory methods and equipment have been greatly improved, so that almost all commutators are now shipped thoroughly seasoned and it is no longer necessary to tighten them in the field. Tightening, therefore, should be done only upon advice from the manufacturer's service department.



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Letters and Comments

Watch Engineer, Tom, Extends Hand

DEAR BILL:

Many thanks for your fine, unselfish letter, page 80 of the June issue. You seem to think that, as watch engineer I shall not be the same old Tom as heretofore. Bill, dispel all such thoughts from your mind. You should know me better.

It is only natural that the full responsibility for a million dollars worth of equipment should make some changes in me, but I hope they shall be for the better.

Let me assure you that we shall not make the 12-8 a prison watch. I know that, in spite of company rules, you make coffee behind No. 3 unit. I know that Pete washes his car at 3:30 a.m. I know that Bob, our swamper, has been known to lift a bag of coal. Bob has seven kids, and gets $25 a week. Bill, it won't hurt me or the company if these things are forgotten. I can look the other way.

More than ever, I shall have to depend on you fellows for cooperation. Just as I lift things from the shoulders of the Chief, so shall you lift things from mine.

Personal likes and dislikes shall not interfere with the work. Therefore, you, Bill, my friend of twenty years, and Mike Tanto with whom I never did get along, shall be regarded in the same light. All ten on our watch shall iron out our own difficulties. How can you think that I shall have to run to the Boss over trifles? Bill, a watch engineer should *HANDLE HIS OWN WATCH* and, with his fellows, present to the organization a picture of a perfectly operated and excellently trained watch. The charts will show, to a great extent, just what cooperation exists on each watch. Steam pressure, feedwater pressure, voltage curve, all steady and true, that's what we'll aim for. And we will succeed. Beginning June 1st, the 12-8 is out for records, not only in plant economics, but in the human phase as well. See you soon, Bill.

TOM.

Problem 7 Still Continues

REVIEWING solutions to Problem No. 7 in March, 1940, issue and comment in June publication, I observe that most correspondents advocate automatic controls and pressure regulating valves, and in my opinion, have missed the most important part of this problem.

The real difficulty lies in the unbalanced condition of temperature and heat load in the two storage rooms. The problem as presented clearly states that at certain hours of the day, the load on 40-deg. room is increased and that results are not satisfactory when the expansion valve is open and worse when partly closed. This proves that when the peak heat load occurs, sufficient ammoina cannot be completely evaporated in the high temperature room to produce desired results. Therefore, it is plain that something must be accomplished to increase the size or efficiency of the evaporator. If a steam boiler is operated beyond its maximum limit, wet steam is the result, while in the case of an evaporator, wet gas will carry over. Naturally, the suction pressure should be kept as high as possible to obtain maximum efficiency and capacity but this is limited by the requirements of the lower temperature room. We can rest assured that if the evaporator is adequate, and the expansion valve is correctly adjusted, wet gas will not carry into the 10-deg. room.

Automatic controls and valves, if properly installed, adjusted and working 100 per cent may be more sensitive and less likely to err than human minds and hands, but this type of equipment will not permit an evaporator to function beyond the limitations of its capacity. Whenever operating troubles occur, many engineers are getting into the habit of saying "make it automatic" and never bother to look into underlying causes and effects. I am heartily in favor of modern control equipment when used in the right place and have seen many important savings and advantages effected thereby but am opposed to the idea of thinking it is the answer to all problems.

Fresno, California W. C. SOWELL.

Etymologically Speaking

I SEE by your May issue that some fellers wants to re-baptize this here guy you call Hero. Maybe you remember that quite a spell back I wrote you all about how I was mesmerized by Madame Zuzu and went to a place called Alexandria where I found a guy who called himself Hero. He's the one who invented what he said was a steam turbine. I admit that it ain't much of a one, but it's still good enough for a big boiler company to use for a trademark. Now be fair, if Hero was good enough of a name for a guy who could invent a trademark two thousand years before there was a boiler company to use it, Hero should be good enough of a name for that little stinkaroo what asks them crazy questions every month.

Look at the dippy names what's been suggested. This Pulverizer Pete alliteration (some word, eh kid?) has everybody buffaloed. You could make those things all day, and none of them is any good. Frinstance,

Anxious Ambrose
Bungling Benny
Cockeyed Clancy
Delirious Dennis
Eccentric Edgar—right on down to
Zany Zeke.

I even hear that somebody wants to name him "Solomon the Seeker." Ain't that dumb? Solomon, you maybe remember, was the feller with a thousand wives, who was still able to sneak out nights to keep dates with the Queen of Sheba. King, or no King, any guy what can do that don't need no help from nobody, which is more than you can say about your nitwit. If you must give him a new name, you oughta call him "Bubbles," cause you always find them in hot water, which is where your hero is most of the time. Besides, Bubbles kind of fits him. I once had a pup and a girl friend named Bubbles.

You say as how you want a running mate for Pulverizer Pete. Your readers ain't the only ones what don't know about Pete. You don't neither. *Running* mate, says you. Why that mug, Pete, would make a snail with arthritis look fast—and on a rainy day, at that. No kiddin, I timed him once, and he took 43 min. to walk a half an hour.

Incidentally (another swell word, I been goin' to night school), Pete is now busy writing that great American novel. He tells me it's all about one of these here Red Communists, and the Red sneaks into a power plant and when nobody ain't lookin' he puts a bomb into the Forced Draft Fan and blows it to bits. The name of the book is "Gone Was the Wind."

Well, I guess by now you realize that you don't need any name for your hero except Hero. And don't forget that I saw him first, and I should oughta be godfather.

Hoping you are the same,

PULVERIZER PETE'S EX-STOOGE.

* * *

Paint is important especially on outdoor electrical equipment. G. W. Penney, manager of the Electrophysics Div. of the Westinghouse Research Lab., says that white paint is a good absorber of long wave lengths but a poor absorber of short wave lengths and may absorb only 25 per cent of solar radiation and reflect the other 75 per cent. On the other hand, white paint absorbs some 95 per cent of the long wave lengths or heat waves which are generated inside a transformer and radiates them out into space. Because of the difficulty of maintaining a clean white surface, a gray paint is more practical.

* * *

Engineers are sometimes astounded at the low unaccounted for steam loss in a well designed and operated district heating system and for comparison. Leven D. Gray, in the Union Electric Magazine, gives the following averages, covering 34 companies for several different institutes: Steam distribution, 14.48 per cent; electric distribution, 13.00 per cent; water distribution, 16.5 per cent; gas distribution, 5.93 per cent. The steam loss is due mainly to radiation, leaks and metering. In one case dropping the steam pressure 35 lb. below normal reduced the condensation loss from 0.0707 to 0.0622 lb. per sq. ft. per hr.

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SEEING IS BELIEVING!

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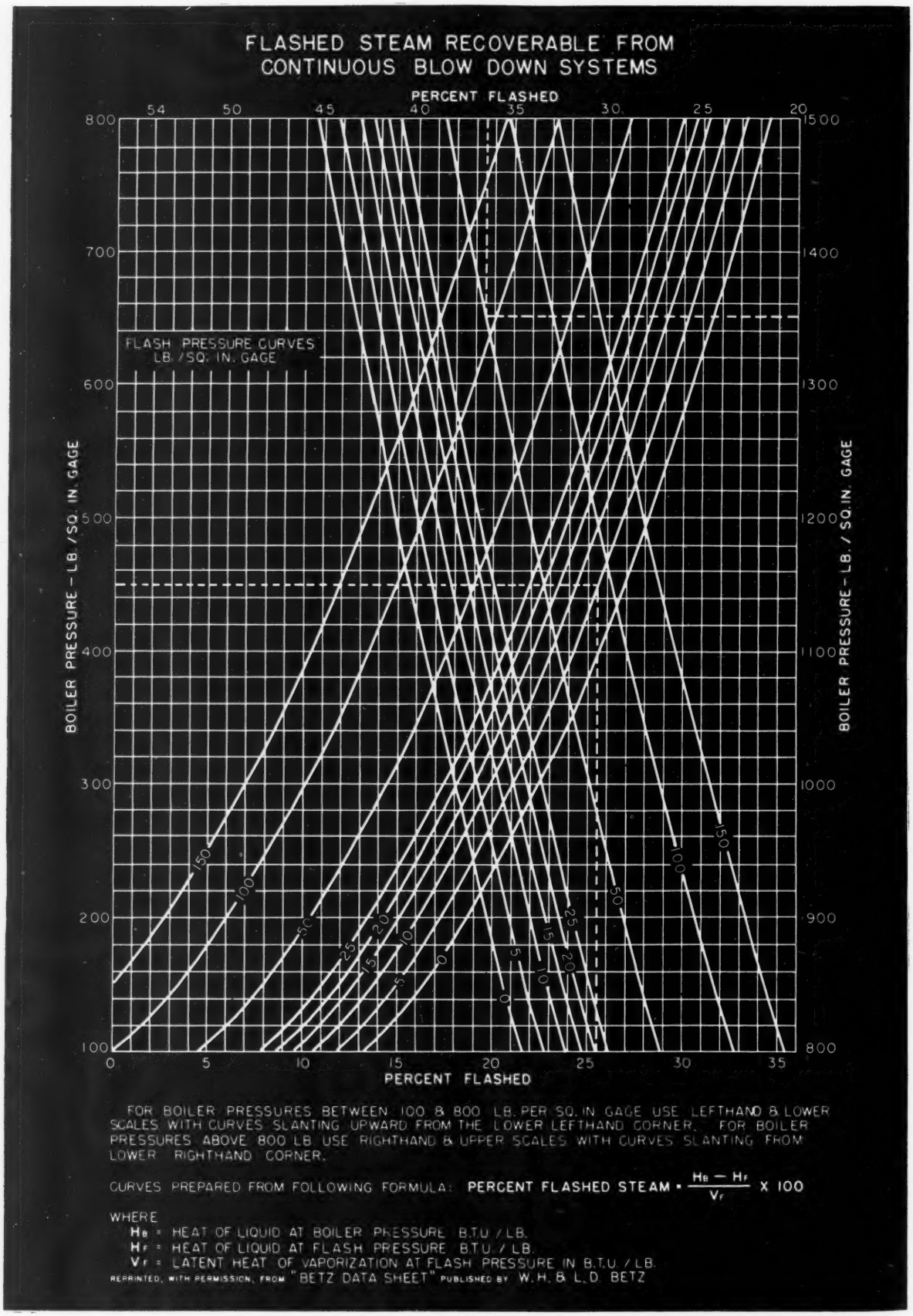
Send for the new Catalog 78, describing the entire line of air devices and we'll include our handy "Guide" which facilitates selection of all Lunkenheimer products according to pressure, temperature, and service applications.


FLASHED STEAM RECOVERABLE FROM
CONTINUOUS BLOW DOWN SYSTEMS
PERCENT FLASHED
54 50 45 40 35 30 25 20
FLASH PRESSURE CURVES
LB. / SQ. IN. GAGE
BOILER PRESSURE - LB. / SQ. IN. GAGE
800 700 600 500 400 300 200 100
1500 1400 1300 1200 1100 1000 900 800
150 100 50 25 20 15 10 5 0
0 5 10 15 20 25 30 35
PERCENT FLASHED

FOR BOILER PRESSURES BETWEEN 100 & 800 LB. PER SQ. IN GAGE USE LEFTHAND & LOWER SCALES WITH CURVES SLANTING UPWARD FROM THE LOWER LEFTHAND CORNER. FOR BOILER PRESSURES ABOVE 800 LB. USE RIGHTHAND & UPPER SCALES WITH CURVES SLANTING FROM LOWER RIGHTHAND CORNER.

CURVES PREPARED FROM FOLLOWING FORMULA: PERCENT FLASHED STEAM = $\frac{H_B - H_F}{V_F} \times 100$

WHERE

H_B = HEAT OF LIQUID AT BOILER PRESSURE B.T.U. / LB.

H_F = HEAT OF LIQUID AT FLASH PRESSURE B.T.U. / LB.

V_F = LATENT HEAT OF VAPORIZATION AT FLASH PRESSURE IN B.T.U. / LB.

REPRINTED, WITH PERMISSION, FROM "BETZ DATA SHEET" PUBLISHED BY W. H. & L. D. BETZ

Atomic Energy Starts New Radio Station

THE NEWLY unleashed energy of the split uranium atom, U-235, was recently used as a working atom for the first time to turn on the new 50,000-watt, air-cooled transmitter of Westinghouse station WBZ, near Boston. During a special ceremony at the new transmitting station in Hull, across the harbor from Boston, the explosive force of a single U-235 atom was released by Dr. E. U. Condon, associate director of Westinghouse Research Laboratories, to start a chain of electrical reactions ending in switching on the new transmitter.

The splitting of the uranium atom was clearly audible to the radio audiences as a sharp click. Two preliminary clicks were heard as two atoms were split to accustom the listener to the sound. On the third click the 200,000,000 electron-volts of the split U-235 atom switched the program from Millis to the new transmitter in Hull. The change-over produced a new surge of power and brought 50 per cent more listeners within easy hearing distance of the station. Closing the network ceremony included a series of musical salutes from WBZ's sister stations, KDKA in Pittsburgh, KYW in Philadelphia, and WOWO in Fort Wayne.

Dr. Condon, who is now conducting experiments on uranium and other elements with the Westinghouse 90-ton "atom-smasher," made the following comment on the splitting of the uranium atom:

"An individual uranium atom is like a bomb containing energy ready to explode but not touched off. Thanks to the discovery of uranium fission, we now know how to touch off these atomic bombs so they release all their stored-up energy at once. When one of the neutrons is shot into the atom in just the right way, it falls apart in two fragments which rush apart with great energy. In one such atomic explosion we get 50,000,000 times as much energy as when an atom of coal is burned.

"If we can learn how to make the process keep going by itself, we shall have in uranium a new fuel which gives off about 2,000,000 times as much energy—weight for weight—as coal or fuel oil.

"It is too soon to be able to say whether uranium will be practical as a fuel. But the work on this process in research laboratories, including our own at Westinghouse, is sure to lead to results of great scientific importance, and it may give us new sources of power."

Although the new WBZ transmitter operates on the same power as the former one—50,000-watts—it sends out waves of double strength which will cover a much larger area and reaches more than a million additional listeners, according to Vincent F. Callahan, general manager of WBZ, who headed the ceremony.

Fig. 1. A view of the apparatus that was used in starting the new transmitter at WBZ by means of the energy derived from the splitting up of a uranium atom. Dr. Condon is shown at the left. The splitting took place inside the transparent cylinder shown mounted on top of the cathode ray oscillograph. A small piece of uranium is placed in the upper part of this cylinder. Dr. William Shoupp is holding a container in which is a mixture of radium and beryllium covered with paraffin to provide a source of slow neutrons, or atomic bullets. The electrical impulse produced by the split uranium atom was pictured on the oscillograph screen and at the same time was amplified millions of times to provide the impulse needed to operate the switching equipment

The double wave strength comes from the use of a directing antenna that reflects the waves bound for the Atlantic Ocean and concentrates the complete power of the station on the densely populated areas.

Modern air-cooled tubes used in the transmitter raise the efficiency of the station from 30 to about 50 per cent. In winter the hot air vented by the cooling system will warm the building.

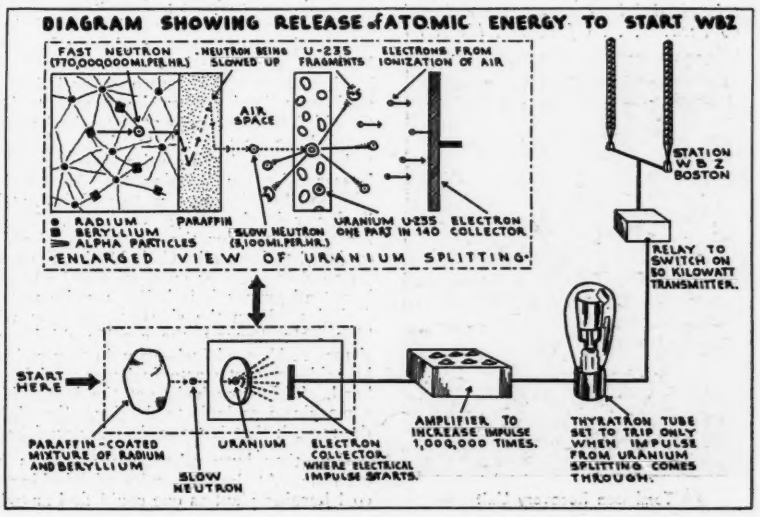


DIAGRAM SHOWING RELEASE of ATOMIC ENERGY TO START WBZ
FAST NEUTRON (170,000,000 MI. PER HR.)
NEUTRON BEING SLOWED UP
U-235 FRAGMENTS
ELECTRONS FROM IONIZATION OF AIR
AIR SPACE
RADIUM
BERYLLIUM
ALPHA PARTICLES
PARAFFIN
SLOW NEUTRON (8,100 MI. PER HR.)
URANIUM ONE PART IN 140
U-235
ELECTRON COLLECTOR
ENLARGED VIEW OF URANIUM SPLITTING
STATION W B Z BOSTON
RELAY TO SWITCH ON 50 KILOWATT TRANSMITTER.
START HERE
PARAFFIN-COATED MIXTURE OF RADIUM AND BERYLLIUM
URANIUM
SLOW NEUTRON
ELECTRON COLLECTOR WHERE ELECTRICAL IMPULSE STARTS.
AMPLIFIER TO INCREASE IMPULSE 1,000,000 TIMES.
THYRATRON TUBE SET TO TRIP ONLY WHEN IMPULSE FROM URANIUM SPLITTING COMES THROUGH.

Fig. 2. HOW IT WAS DONE: Neutrons (neutral atomic particles) from a mixture of radium and beryllium are slowed down in passing through a coating of paraffin and strike a small target of uranium about the size of a dime. One atom in 140 of the uranium will be in the form known as U-235. About once in every 10 seconds a slow neutron hits the nucleus, or heart, of a U-235 atom and shatters it into five parts—two new atoms of different elements and three neutrons

As these fragments fly apart with an energy of 200,000,000 electron-volts, they ionize (electrify) the air in the apparatus and permit a small electric current to flow through a circuit. Following an amplification of about a million times, the current is strong enough to trip a thyratron tube which in turn operates a relay to switch on the new transmitter.

'Round About with the

A BUSINESS TRIP following a vacation in the Canadian Rockies is a terrific let down. After the mountains, the cities—the best of them—seem futile, sordid; stone pavements and motor cars are poor substitutes for hanging glaciers and alpine meadows . . . But one must live, and the wolf ever lurks at an editor's door, so we came down from the high places to look over the power plants in the Northwest, permitting business to interfere with pleasure as little as possible . . . And it is quite easy, in the Northwest, to mix business with pleasure, provided one's conscience is flexible enough; mine is . . . To begin with, the people are friendly and hospitable, there is little red tape. If you see a power plant, you just walk in and the chances are ten to one you'll get a cordial welcome . . . If you want to take pictures, you take them—it doesn't require an act of congress to get permission. Or, if you want to climb up on the hogged fuel pile just for the thrill of it, you climb up. The natives may think you're a bit nuts for doing it but they let you amuse yourself . . . And there are plenty of hogged fuel piles; there is one in almost every plant yard . . . Wood is ubiquitous in the Northwest—it seems unending, part of ever landscape . . . Cut lumber, piled up in yards, logs on cars, on trucks, floating in rivers, on tidewater, going up conveyors, being cut into boards or fashioned into plywood. Plywood factories all over, sash and door plants, furniture, chips, refuse, pulp wood—wood in all forms, all over. Great logs, 2, 3, and 4 ft. in diameter jammed in log ponds awaiting their turn to be cut up like pigs in a stock yard . . . All down Puget Sound, from Bellingham to Olympia and down the coast to the Columbia, nothing but timber—millions and millions and millions of feet of it . . . But the once lovely hills are denuded; all the traveler on the coast sees is scrub, cut over land, second growth stuff. The great logs for the lumber mills come from far away—as far away as they can be floated . . .

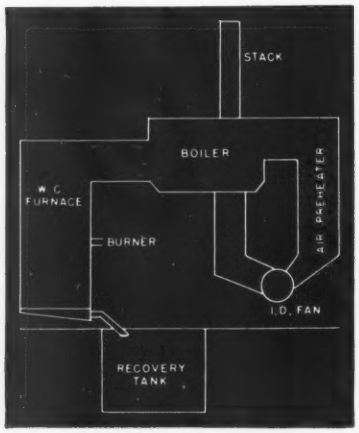
"Go West, young man," said a certain editor many years ago. A lot of men (and women, too) must have taken Horace Greeley seriously because nearly everybody we met in the Pacific Northwest, at least of the middle-age class, seemed to have come from "back east" or the middle west. Strangely enough, or maybe not so strange, none of them are sorry they came—none would ever go back . . . Well, it is a great country, with plenty of what Mr. Hitler calls "Lebensraum" but no place for Mr. Hitler . . . A land of abundance—fruit, vegetables, dairy products, meat and fish . . . Prices (retail) at the Seattle market: Lettuce, 2 heads for 5c. Radishes, 10 bunches for 10c. Melons, 5 for 25c. Carrots, 6 bunches for 10c. String beans, 5c a qt. Tomatoes, 5c a lb. . . . The chief engineer of a small plant in Tacoma said his winter fuel bill was $35. His electricity, for cooking, lighting, refrigeration and hot water heating (at ¼c per kw-hr.) averaged $4.00 a month.

"Go back!" exclaimed one consulting engineer I talked to—I was curious about this—"Why should I? Out here I have everything I want. I have my own car, my own airplane, my own 40 ft. cruiser which accommodates 15 persons and sleeps 6. I have a fine 10 room house in the best residential part of town, my boy goes to the best schools in the state, I belong to the best clubs, I have a good business and fine associates, and all of this costs me (hold your breath) forty-five hundred dollars a year. Why should I go back?" . . . Of course, his is an

The Lumber Industry? There is no such thing; just a great collection of individual mills, unorganized, each one for itself and the Devil take the hindmost, cutting lumber where it is available, following the forests . . . A lumber mill has a life of 10 to 15 years, then it moves on to where the timber still is . . . And the waste! The obvious, enormous waste is shocking to one who loves the cheerfulness of a wood fire; all because somebody cannot make a profit on it . . . Open refuse burners, burning wood ingloriously, fuel that other people need and want . . . I thought of Carl Crow's book on the Chinese in which he describes the constant, toilsome search for fuel in China—where every twig or bit of straw is treasured, where heaps of cinders are tediously sorted to garner any which have not been entirely consumed . . . In one power plant the chief engineer said that at times the boilers were deliberately permitted to become dirty so the furnaces would burn more wood refuse. This case was exceptional, to be sure but it reflects an attitude . . . It takes a hundred years to grow a tree—just one minute to cut it up into boards . . . And now we have the roving lumber plant, a small mobile outfit with a Diesel engine or electrically operated; it follows the lumber and moves on when it is gone . . .

With so much waste fuel, the philosophy of power plant operation is different, less emphasis is placed on efficiency; first cost, therefore, becomes more important. In the plywood mills, second-hand power equipment is the general rule. These plants also follow the timber and their life is limited to 10 or 15 years . . . G. P. McManama can tell you all about this if you go to see him in Seattle. He has built a lot of plywood power plants and he knows the economic aspects. The investment in plywood power plants he says is often limited to a figure which enables the plant to pay for itself in a matter of 3 to 5 years. This rules out new equipment. U. S. Plywood at Seattle is a good example of this type plant. Built most of second-hand equipment, the plant operates 7 days a week; any repairs to the brickwork are made on a Sunday when the plant shuts down, once in 3 or 4 months. S. M. Gilbert, the chief engineer, says at times he has laid brick with the boilers in operation; he showed me how . . . Lots of old, "haywire" plants in the lumber mills—not much to look at, still less to write about . . . The big lumber companies, Longbell, Weyerhauser, Simpson Logging Co., have fine plants—modern, efficient and well kept. Simpson Logging, as a matter of fact, at its Shelton, Wash., plant has the only 900 lb. boiler in the entire Northwest. Together with a 3000 kw. tubro-generator it forms a "top" for the old 180 lb. plant. It operates on hogged fuel and is also equipped to burn oil. C. J. Macke, the manager at this plant, is an old lumber man (not old in years or outlook) but he knows his engineering. Hogged fuel, he says, is not all gravy; it is bulky, usually wet, and requires large storage and conveying facilities. Even the shortest conveyor will cost $5000, and maintenance costs are high. Mr. Bennett, the capable chief operating engineer, keeps this plant in fine shape . . . Hogged fuel—why do they call it that? I asked Mr. McManama. "Well," he said, "at first waste fuel was used in the form of sticks and slabs and fired by hand. Then somebody got the bright idea of cutting it up into small chips and a machine was built to do this. Somebody watching this machine in action made the remark that it was a *hog* for punishment and so the term stuck."

But they burn other things besides hogged fuel in the Northwest—coal, for example. At the University of Washington I found as fine an example of modern coal burning plant as one could find anywhere. A 70,000 lb. per hr. integral furnace,



Tomlinson Recovery Unit

ELECTRICAL EDITOR

pulverized coal fired unit under complete automatic control, including electronic flame failure protection. Mr. Gross, the chief engineer, was away on his vacation when I called but Mr. Robbins, the assistant chief, explained the workings. The flame failure device is intriguing, to an old radio ham at least. A photronic cell mounted in the top of the furnace watches "the flame at the burner. If the flame goes out, presto! the coal feed stops and the fans close down and everything is safe . . . "

Black liquor! I though it was some kind of hootch but at Longview Fibre I found it was a by-product of the paper industry. They burn it . . . It's vicious looking stuff—the tars and resins that are boiled out of the pulp wood. Comes out of evaporators at 200 deg. F., black, tarry and sticky. Sprayed into the furnaces at 50 lb. pressure, it sticks to the furnace walls and as it accumulates, dries and falls off. It burns down below, where primary air is introduced. Through peep holes you can watch it, a quivering seething inferno—the Devil's own playground . . . A new Tomlinson recovery unit at this plant will burn the black liquor and produce steam at 200 lb. pressure . . . The residue remaining after the liquor has been burned is the inert, inorganic matter which forms the recovery product . . . The general arrangement of this equipment is shown in the diagram. The black liquor is sprayed into a water-cooled furnace. The gases pass to the boiler and the residue, Na_2SO_4 is tapped off into a recovery tank filled with water. The black liquor has a heat value of 3765 B.t.u. per lb., H_2O, 45 per cent.

If you want to see a swell record system, take a trip up to the Weyerhauser plant at Everett, Washington, and get Mr. Brazeau or the chief engineer, Carl Ries, to show you how they keep their plant records . . . Specially built racks holding drawers that slide in and out, accommodating huge charts containing up to the minute data on every operating and maintenance item in the plant. One man devotes his entire time to keeping these records . . . This Weyerhauser plant is another fine example of wood burning plant—three 60,000 lb. per hr. each, 650 lb. pressure boilers, burn hogged fuel and oil . . . Nearly all these plants use dutch oven furnaces with water cooled grates . . . The water cooled grates are hooked up in all sorts of ways. In some they are connected directly into the boiler circulating system, in others the water is wasted, in still others it is used in process work. At Station L of the Portland Electric Co. the arrangement shown is used. At Northwestern Electric in Portland, solid grates built over a low ash pit containing water does the trick . . . The hogged fuel piles of the two Portland utility companies vie with each other for size. Northwestern had the edge when I was there with 30,000 units, whereas Station L the pile was only 25,000 . . . That's a lot of fuel when you consider a unit is 200 cu. ft. Mr. Briggs, the chief engineer at Station L, mildly suggested that I might want to climb to the top, but I tactfully declined—I had climbed more interesting things. At Norhwesern Electric, Mr. Hooper, who proved to be an old Navy classmate of mine at Stevens Institute, was proud of his hydraulic unloading crane. It worked fine.

The highest power plant I visited was the one on Mt. Hood, at Timberline Lodge. Here, at an altitude of 6000 ft., I found a 60 hp. Diesel electric plant supplying power at 2300 v. for the ski lift. The ride on the ski lift—a mile long chair type lift—at 8 o'clock at night was strangely fascinating and when I got off I had to find out what made it "go". A tiny plant but nicely arranged and very effective. Another similar Diesel plant supplies the Lodge with light and power.

Despite all this about steam and Diesel power plants, the really great power of the Northwest is its "white" coal. Few regions in the world have such an abundance of water power. With Bonneville and Grand Coulee power soon becoming available, there will be fewer steam plants . . . Bonneville power can be delivered in Portland for around 3 mills . . . Bonneville is now delivering some 46,000 kw. to the Portland area. In January, 1941, another 100,000 kw. will be available. By September, 1941, Grand Coulee will put on its first 91,500 kw. unit . . . This water power has worried a lot of people, particularly in the East, but the West is finding use for it. In Southern California all the Boulder Dam power is already in use. In Portland, the Aluminum Co. of America has just built a new plant which will take 27,000 kw. of Bonneville power this month (Sept.). The Pacific Carbide and Alloys Corp. is also building a new $250,000 plant to go into operation in October. Bonneville power was a determining factor in locating this plant.

Grand Coulee continues to amaze me. Its size, its scope, its humanitarian and sociological aspects and its economic value all mark it the most valuable single task man has ever undertaken . . . This week, we contracted for the construction of 7 battleships at a cost of $100,000,000 each. There was no quibbling about this. Why quibble about a mere $400,000,000 for a project such as this over a period of 50 years?

Andrew Kramer

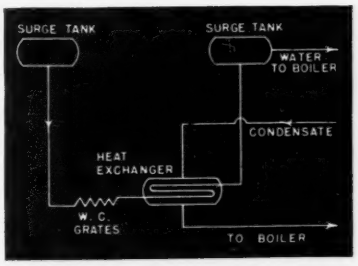
outstanding case—not all the West is like that, but on the whole, the common people seem more satisfied, there is less stress on the importance of money.

* * *

Grand Coulee was a hot place, it usually is in summertime, but down in the power plant it was cool. The temperature there, they told me, never varies throughout the year from around 56 degrees . . . When the dam is finished next year, there will be some eight miles of tunnels in the dam for visitors to walk through . . . Startling is the difference between the Columbia River and the Colorado in terms of flow. After Boulder Dam was completed it took over three years for Lake Mead to fill up. At Grand Coulee, once the dam is finished, the Columbia will fill up the 150 mile long lake behind it in a matter of about three weeks!

* * *

A fine example of fluorescent lighting was found in the drafting room of the Bureau of Reclamation at Grand Coulee.



W. C. Grate System at Station L

This installation replaced an incandescent lighting system. With a power consumption of 4000 watts, the incandescent system provided an intensity of 50 ft. candles. Now, with fluorescent, an intensity of 100 ft. candles is obtained with a power consumption of only 2600 watts. It consists of 60—4 ft. (40 watt) lamps. Two hundred watts are lost in the auxiliaries. Q.E.D. $60 \times 40 + 200 = 2600$ *watts.*

* * *

The trip from Vancouver to Seattle by C. P. R. Steamer was like a trip on a private yacht—so few passengers . . . It is a reflection upon the intelligence of the American traveling public to have to seriously swallowed the dire rumors (5th columnist activity?) of the difficulties of getting in and out of Canada. All sorts of strange and dreadful tales are heard, none of which seem to have the slightest foundation . . . We encountered less difficulty in getting across either way this year than we have in any of the 15 years that we have been going to Canada and we had no passports or birth certificates with us . . . Yet the trains and boats were almost empty of the usually ubiquitous Americans . . . The Canadian Government welcomes American tourists and what's more, your American dollar is worth more in Canada.

* * *

Electric vibrators are used at Grand Coulee Dam in placing the concrete. After the concrete is poured one of the vibrators is inserted and the whole mass quivers and runs into place. Made for 60 cycle current they originally vibrated at 3600 vibrations per min. They were found much more effective at 4800 vibrations per min. so now motor generators are installed along the crest of the dam to supply the necessary 80 cycle current.

Diesel Engines Underground*

INTEREST in the possibility of using Diesel engines for haulage power in mining and tunneling is increasing in the United States, owing largely to the reported successful use of Diesel locomotives in European coal mines and to the comparatively recent development of automotive Diesel engines in this country. The extent of this interest has been evidenced to the Bureau of Mines by numerous requests for information as to the factors that must be considered if Diesel engines are to be used safely underground.

Proponents of the application of the Diesel engine to underground haulage base their claims for its safety upon a comparison with the gasoline engine, assuming that (1) the carbon monoxide content of Diesel exhaust gas is always low and that (2) fire and explosion hazards from Diesel fuel are minimized because of its low volatility.

In these respects the Diesel engine appears less hazardous than the gasoline engine, whose use underground has been discouraged by the Bureau of Mines and other organizations interested in safety in mining. However, such generalizations cannot be accepted as conclusive evidence that safety is inherent in Diesel engines in underground service, as European experience indicates that certain hazards may accompany their use.

Exhaust gases from any internal-combustion engine may not be discharged with safety in underground working places unless ventilation is provided to dilute and remove the toxic or objectionable constituents and to maintain the oxygen content of the atmosphere at safe concentrations.

Exhaust constituents that may create harmful or objectionable atmospheres are carbon monoxide, oxides of nitrogen, carbon dioxide, aldehydes, soot, and oxides of sulfur (if the fuel contains sulfur). The exhaust also contains water vapor, oxygen, and nitrogen, and, under some conditions, hydrogen and methane or other hydrocarbons.

Widespread publicity given the hazards of carbon monoxide and its general association with internal-combustion engines probably explains the fact that this gas has received the most attention. Statements that the carbon monoxide content of Diesel exhaust is negligible cannot be accepted without question if the results of European studies and the many variables that may affect combustion in a Diesel engine are considered.

The ratio of fuel to air during combustion, the intimacy of their mixing and the nature of the atmospheric environment in which the engine is operated all may affect the composition of the exhaust. In addition to carbon monoxide, other gases, such as oxides of nitrogen, carbon dioxide, and oxides of sulfur, may cause significant health hazards. Soot and products of partial oxidation, such as aldehydes also may occur in objectionable concentrations.

The Bureau of Mines has initiated a study of the hazards that may attend the use of Diesel engines underground to obtain firsthand information that may serve as a basis for recommending safe practices under conditions existing in the United States.

Excess Air

These experiments showed that high concentrations of carbon monoxide were produced when the chemically correct fuel-air ratio was exceeded. Operation of an engine under this condition could result from several circumstances, but it appears that the most probable causes would be (1) injection of more fuel than could be burned completely by the air taken into the engine and (2) restriction in either the exhaust or intake system that would diminish the quantity of intake air to less than required for complete combustion. Operation of Diesel engines at fuel-air ratios on the rich side is shown to be undesirable because of production of high concentrations of carbon monoxide and decreased economy.

The experiments show (1) that ventilation must be provided if the exhaust gases from Diesel engines are discharged in underground working places; (2) that because of their toxicity, carbon dioxide, carbon monoxide, oxides of nitrogen, and oxides of sulfur (if the fuel contains sulfur) in the exhaust are the constituents of chief significance in relation to ventilation; and (3) that Diesel engines in underground service should not be operated at fuel-air ratios on the rich side because under this condition the exhaust contains high concentrations of carbon monoxide and soot.

It appears desirable to furnish an excess of ventilation rather than to adhere to the minimum quantity indicated by calculation. Further study of Diesel engines in the laboratory and under actual operating conditions should furnish a basis for deciding the proper magnitude of this margin of safety.

Pending further investigation and development of definite recommendations on ventilation required for use of Diesel engines underground, the following suggestions for safe practice in such application are included:

Engines should be tested to determine the amount of ventilation required and also to insure that operation is restricted to a safe range of fuel-air ratios.

After an engine is placed in service underground and ventilation is supplied, the atmosphere in which the engine operates should be examined frequently to determine whether objectionable constituents of the exhaust are within the permissible limit.

Ventilation should be increased if results of such examination indicate that this is necessary to maintain safe and healthful conditions, but under no circumstances should the quantity of ventilating air be reduced below that estimated from tests made before the engine was placed underground.

The engine should be inspected frequently to prevent or correct maladjustments that might increase production of objectionable consituents in the exhaust.

Inflammable Atmospheres

In the use of Diesel engines underground, the possibility of igniting inflammable atmospheres must be considered. Among possible ignition sources associated directly with the engine are exhaust gases at high temperature, incandescent solid particles in the exhaust, and heated engine surfaces.

Positive cooling of the exhaust gases and the exhaust manifold and piping appears a desirable precaution against ignition of inflammable atmospheres. Cooling of the exhaust gases by a water spray or by passing the gases through water has the additional, and probably most important, effect of quenching incandescent particles in the exhaust before they are discharged into the surrounding atmosphere.

*A short abstract of a complete investigation reported in Bureau of Mines Report of Investigation 3508.

New Equipment

Information that you desire about any equipment will be gladly furnished without obligation. WRITE POWER PLANT ENGINEERING.

Adjustable Wrenches

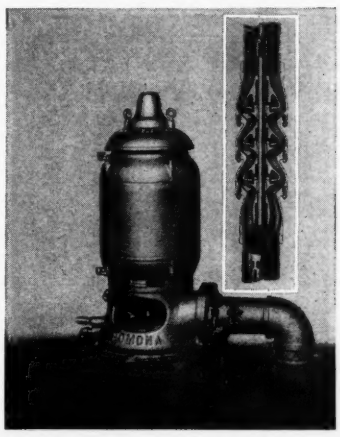
BONNEY FORGE & TOOL WORKS, Allentown, Pa. has announced a complete line of open end adjustable wrenches in 4, 6, 10 and 12 in. lengths with capacities of ½ to 1 1/16 in. They are drop forged of high-grade, alloy steel. Both handle and jaw are hardened and tempered in oil. Four tempered threads meshing in

the forged jaw permit great pressure on the handle. They will not break or wear in the gear teeth and allow play, thus eliminating the possibility of the jaw slipping off the nut. Jaws are designed to fit square or hexagon nuts and are unusually thin permitting use of these wrenches in normally inaccessible places.

Vertical Turbine Pump

THE POMONA PUMP CO., Pomona, Cal., announces the complete redesign of its line of 6 in. medium capactiy vertical turbine pumps. As a result of improved engineering practice, particularly in the newly designed impellers and seats, the manufacturer states that the new models afford higher efficiency and better performance, resulting in lower cost for the user.

For a desired capacity of 100 g.p.m. against 110 ft. lift in a well and 50 lb. pressure above, a 7½ hp. motor is required, as against a 10 hp. motor with the old model. The efficiency of this particular size pump for this head capacity has been increased 6½ points, the number of stages has been reduced one-fourth and finally, the initial cost of the entire unit has been lowered 20 per cent.

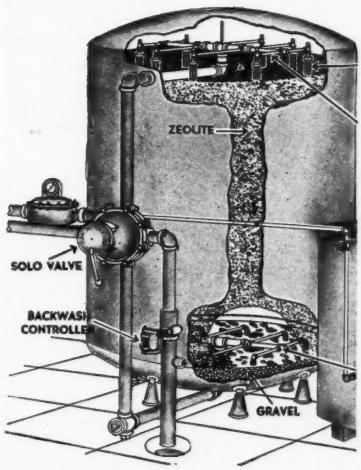


Other advantages of these pumps, making for extremely low operating costs, lie in the facts that they are water-lubricated, with no stuffing box below ground level; that the specially-designed semi-open impeller can be adjusted from the surface for wear and for changing capacity; and that they are non-sandlocking and non-gaslocking.

Constructed of high quality bronze, the Pomona semi-open impellers operate in a cone-shaped seat in the pump bowls. Correct curvature of the impeller vanes assures maximum lifting capacity and prevents overloading of motor regardless of changes in water level.

Increasing Softener Capacity

A NEW METHOD of controlling the distribution and flow of water in a Zeolite softener has been announced by the Elgin Softener Corp., Elgin, Ill. This new principle, known as the Double Check Strainer System, is shown in the accompanying illustration. Its purpose is pri-



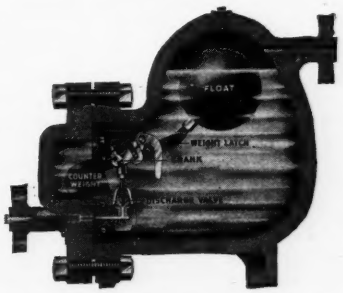
marily to prevent the loss of zeolite; to obtain better water distribution; to increase the capacity of a water softener; and also to permit the use of a larger amount of zeolite in a softener of given size. With the larger amount of zeolite that can be used, it is said by the manufacturer to increase the capacity of a given size softener 25 to 35 per cent and to make an appreciable saving in the salt required for regeneration.

The following benefits are said to be secured: First, by preventing the loss of zeolite, a deeper bed can be used, giving increased softener capacity. Second, a better distribution of water through the bed is obtained so as to increase softening efficiency. Third, better salt distribution is obtained with accompanying salt saving. Fourth, a regulated back-flow rate—faster flow rates through the coarser zeolite and slower rates through the finer zeolite, preventing channeling and matting and makes the softener self-cleaning. Fifth, elimination of the gravel underbed (when using synthetic zeolite) which gives more space for zeolite and still further steps up softening efficiency.

The double check method is used in the new Elgin Softeners, but may be applied to softeners already installed as well. According to the manufacturer, the double check method is the answer to those requiring more softening capacity in smaller space from a new softener or increased capacity from existing equipment.

High Pressure Trap

W. H. NICHOLSON CO., Wilkes-Barre, Pa., announces a new high pressure weight operated trap for pressures from 500 to 1,500 lbs. with a maximum total temperature of 1,000 deg. F. It has connections of ½-¾ and 1 in. for steam, air



or gasoline. Its construction features stainless steel working parts and is of automatic intermittent action. It is said to be unaffected by re-evaporation of condensate due to high superheat.

Electric Solderer

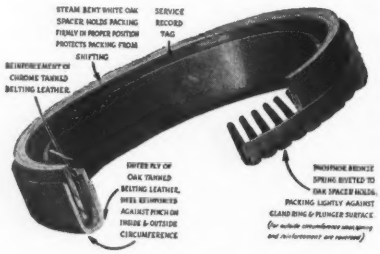
A TREADLE operated spot soldering machine, as illustrated, is manufacturer by the Electric Soldering Iron Co., Inc., Deep River, Conn. It has an adjustable feed tube used to guide the solder and

a regulating pawl lever which actuates feeding gears. The treadle has a tendency to advance the iron straight downward. The machine is ideal for work where both hands are required and where the solder cannot be hand applied. Solder up to ⅛ in. dia. can be used.

Double U Packing

WAYNE DAVIES PACKINGS, INC., 325 West Huron St., Chicago, Ill., are now in production on their new reinforced hydraulic U packing and are equipped to furnish packings in section sizes from ½ to ⅞ in. inclusive, for plunger diameters from 9 to 90 in. Equipment is now being installed for the manufacture of all section sizes from ¼ to 1¼ in.

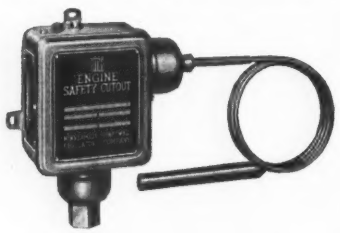
This new type packing is designated Double U because the wear wall and heel are doubly reinforced against wear on the contact leg and against pinch from excessive clearance between plunger and gland ring. They can be reinforced with


STEAM BENT WHITE OAK SPACER HOLDS PACKING FIRMLY IN PROPER POSITION PROTECTS PACKING FROM SHIFTING
SERVICE RECORD TAG
REINFORCEMENT OF CHROME TANNED BELTING LEATHER
PHOSPHOR BRONZE SPRING RIVETED TO OAK SPACER HOLDS PACKING LIGHTLY AGAINST GLAND RING & PLUNGER SURFACE (for outside circumference sealing and reinforcement are reversed)
EXTRA PLY OF OAK TANNED BELTING LEATHER, HEEL REINFORCES AGAINST PINCH ON INSIDE & OUTSIDE CIRCUMFERENCE

any adaptable material over the U packing base. The standard reinforcement is tough chrome tanned belting leather backed by the firmness of oak tanned belting leather stock. They are automatic in adjustment to any pressure. The white oak spacer is steam bent to the packing channel, forming the frame to which the phosphor bronze spring is secured, and fits snugly against the outer lip or outer circumference of the U. The oak spacer extends beyond the packing lips and serves by its contact with the end of the packing recess to hold the U packing in position to seal at all times. The spacer cannot fall or float out, nor can the lips of the packing collapse, shrink or curl during the periods when no liquid is present in the packing recess.

Engine Safety Cutout

A NEW safety device, the Engine device, the Engine Safety Cutout, is announced by the Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. It is designed to protect stationary internal combustion engines by interrupting their operation if the lubricating oil pressure drops hazardously low or if the cooling water temperature rises too high. It provides an insurance on engines that operate for long periods of time unattended.

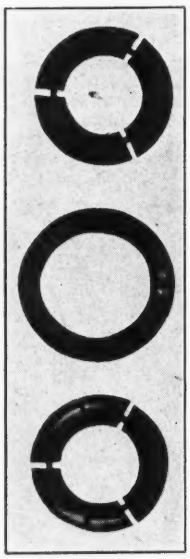


The engine cutout comes in two models, P607A, which is equipped with a manual reset button, and must be depressed before the motor will start. While model P607B is minus the manual reset and is designed for use on motors with automatic starting equipment.

Packing

RODPAK MFG. CO., San Francisco, Cal., manufacturers of Rodpak Metallic Packing, announce an important improvement designed to facilitate installation and give a more positive shaft seal. This packing (previously described on page 225 of the March, 1939, issue) consists of segmented metallic rings alternating with neoprene rings. The design with convex and concave surfaces being such that the neoprene rings are forced out to seal the walls of the stuffing box while the metallic rings are forced inward to seal the shaft or rod.

The packing is applicable to either rotating or reciprocating shafts. On the former, rotation of the metallic rings is prevented by beryllium-copper inserts in the neoprene ring which fit recesses in the metallic rings. On reciprocating rods these springs exert an added inward thrust on the metallic rods which compensates for rod irregularities or alinement. In the illustration these springs can be seen in the center or neoprene ring.

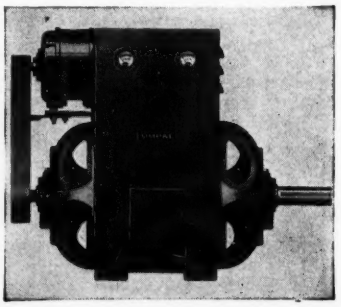


The two outside views are the metallic rings, flat on one side, curvex on the other and cast in three segments. Formerly these segments were held together by small wires cast in the segments, one of which had to be broken for installation. In the improved construction these wires have been replaced by small coil springs, which can be disengaged for installation and again fastened to hold the segments together. The packing is suitable for saturated or superheated steam, ammonia, air, water, hot oil, acids, or other liquids or gases.

New A-C Power Unit

A NEW and completely self-contained a.c. generating unit which regulates, controls, and meters its output has been announced by the Westinghouse Electric & Mfg. Co. Called the "Simpac" power unit, it combines a standard open-type a.c. generator, a direct current exciter, exciter field rheostat, voltmeter, ammeter, and optional voltage regulator in one integral unit. The "Simpac" was designed especially to fill the need for a completely self-contained generating unit for use in out of the way localities, or for special requirements in industrial plants. It may be either engine or electric motor driven, direct or belt connected.

Voltage is adjusted manually by the exciter field rheostat, the voltmeter being in plain sight of the operator. Generators employed have an inherent voltage regulation of 10 at 80 per cent power factor. Should this not be sufficient, the voltage



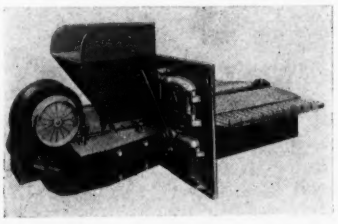
variation may be improved to as low as 1½ per cent by use of a "Silverstat" automatic resistance type regulator. Space for the "Silverstat" is provided for in the control cabinet.

Ratings from 3.75 to 187 kv-a. are available voltages of 120/208, 240 or 480, with operating speeds from 600 to 1800 r.p.m. Units above 187 and up to 312 kv-a. may be obtained with separately mounted controls. All come wired and assembled.

C-E Low Ram Stoker Unit

TO MEET the demand for a small ram-feed underfeed stoker, Combustion Engineering Co., New York, has brought out the C-E Low Ram Stoker Unit, designed to burn either coking or non-coking bituminous coals under boilers up to 250 hp.

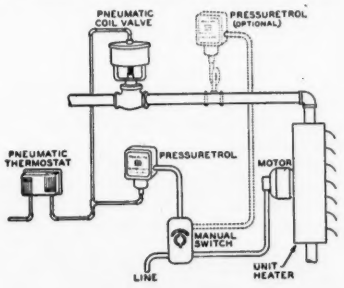
This is a low-set, electrically-driven unit with stationary grate bars and cantilever-type dump grates, the body of the



stoker being only 16 in. high. A forced-draft fan, fitted with vortex-type inlet damper and directly connected to the stoker-drive motor is incorporated as an integral part of the unit. The motor is of the constant-speed type, mounted directly on the gear case and connected to the reduction-gear train by an enclosed silent chain, and a safety release coupling protects the drive mechanism against overload resulting from any obstruction in the feed.

Unit Heater Control

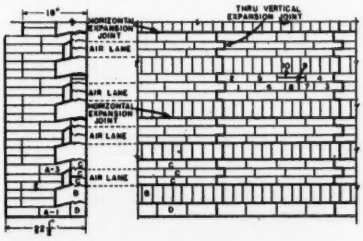
MINNEAPOLIS-HONEYWELL REGULATOR Co., Minneapolis, Minn., announces a new unit heater control system which provides a continuous air movement and prevents hot blasts of air. The system may either be pneumatic or electric, the former being more desirable in industrial buildings because a compressed air supply is usually available and is less expensive.



This system provides a modulated continuous flow of steam under control of a thermostat; continuous automatic fan operation only when steam is on the unit heater; a manual off-on automatic switch for the fan, and, if desired, a means of automatically shutting off the fan when there is no steam pressure in the main steam line.

Furnace Walls

FOR SOLID or air cooled furnace walls, The Waite Construction Co., Providence, R. I., offers a sectionally supported all brick furnace wall construction said to involve a new principle of design. Special construction applies only to the inner 9 in. of exposed lining using a small number of special fire brick shapes. The balance of the wall is of standard brick. The special brick have the same overall dimensions as standard brick and, it is said, can be conveniently laid up by the ordinary brick laying methods.

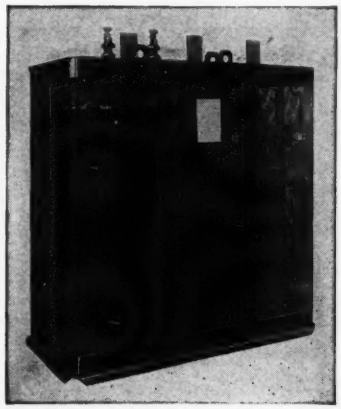


Construction provides for expansion joints to relieve vertical as well as horizontal expansion in the inner 9 in. of exposed wall. These vertical and horizontal expansion joints divide the inner lining into small conveniently sized rectangular self supporting panels with no expensive supporting steel work.

Special 5 in. rollock headers anchor each panel firmly to the outer supporting section of wall on the principle of the inclined plane. The weight of each panel is progressively transferred to cooler outer supporting section of wall. Each course of exposed headers carries the weight of only one panel. Exposed headers in the bottom of the wall carry no greater load than those in the top of the wall.

New Air-Cooled Transformers

AN ADVANCED design of air-cooled transformers providing a higher factor of operating safety than ever before realized has been announced by the Westinghouse Electric & Mfg. Co. With 60 cycle ratings ranging from 150 to 500 kv-a. inclusive for single phase and 150 to 1000 kv-a. inclusive for 3 phase, voltages 13,200 v. and below, type ASL transformers are designed specifically for installations in buildings where safety is essential. Because no fire and explosion hazards are possible with this design, substantial savings are obtained by the elimination of protective vaults. Improved regulation and increased output is obtained because these transformers may be located near the load center, thus permitting short secondary cable runs.



The housing is constructed of expanded metal finished in a black baked-on moisture-proof enamel which permits a free and easy flow of air from all sides and provides safety against accidental contact with live terminals. The primary and secondary coils are separated by liberal air spaces through which a stream of air constantly circulates. The windings are designed for a 75 deg. C. temperature rise under continuous full load operation.

Heat resisting insulation, including porcelain, asbestos, mica, glass and air (inorganic materials) are used throughout allowing operation at higher temperatures than are permissible with liquid filled transformers.

Centrifugal Refrigeration Units

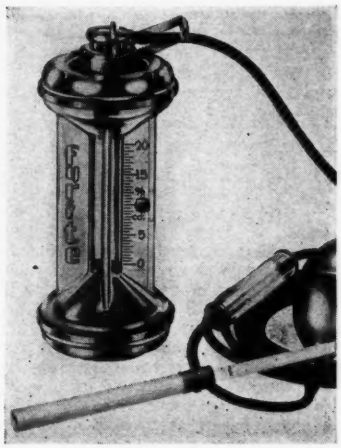
THE SUCCESSFUL performance of three installations of centrifugal refrigeration equipment for air conditioning service, by Worthington Pump and Machinery Corp., has led that organization to develop a complete line of such units in a range of capacities from 150 to 650 tons. The installations referred to are the Strand Theatre, New York City; Rollman's Department Store, Cincinnati, and the National Gallery of Art, in Washington. The latter is a three unit system of 1050 tons capacity.

Impeller and casing designs incorporate the most modern practices in both hydrodynamics and centrifugal pump construction. Speeds are relatively low, ranging from 4000 to 5400 r.p.m. and pressures do not exceed 15 lb., a significant safety factor resulting from the use of Freon-11 as the refrigerant, with its low evaporating pressure.

A feature of particular interest is an auxiliary oil pump, operating independent of the main drive for furnishing full pressure lubrication to all bearings during starting and stopping periods. In starting, the main power can be applied only after the auxiliary pump is automatically cut in as soon as the main power is shut off.

CO_2 Analyzer

FOR MEASURING the percentage of CO_2 in the flue gases of boiler furnaces, Bacharach Industrial Instrument Co. has announced a chemical type CO_2 analyzer known as Fyrite. An important new feature is the gas sampling equipment which includes a primary flue filter with a replaceable filtering thimble. A flue gas sample of known volume is pumped to the instrument by hand with a rubber bulb



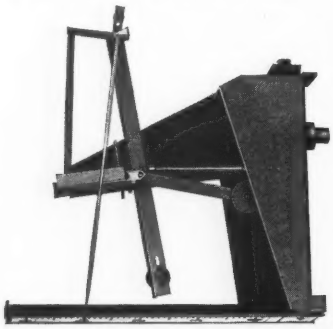
and trapped in the instrument automatically by pulling off the sampling hose. The instrument is then turned upside down and back again to mix the gas sample with the absorbing reagent, which is said to be good for several hundred samplings before replacement is required. The suction created due to the complete absorption of the CO_2 pulls the absorbing fluid up an amount equal to the CO_2 absorbed. Consequently, its level shows the percentage of CO_2 in the gas.

Drum Type Master Switch

CUTLER-HAMMER, INC., Milwaukee, Wisc. announces new drum type master switch which provides 3-wire control for machine tools and other equipment. This new type switch affords functions equivalent to two and three button heavy duty push button stations and is offered for use where an operating lever is preferred. Three kinds of constructions are available—surface, cavity, and panel mounting—and two kinds of handles, standard and pistol grip. By removing a stop post, the drum may be converted from non-reversing to reversing. Ratings of the new drum type master switch are for pilot circuits up to 600 v. a.c. and d.c.

Draft Gage

ELLISON DRAFT GAGE CO., 214 W. Kinzie St., Chicago, Ill., announces the development of the new Straight-Line Diafram draft gage employing the Ellison differential, a new and simplified system for transmitting the diafram movement directly to the beam. This consists



of a piece of flexible piano wire moving through a substantially air tight babbit sleeve. The gage has a high power, free floating diafram, consisting of fine mesh, pure silk cloth, coated with a pliable air tight synthetic coating. The scale is of a permanent white plastic material, nonbreakable and non-inflammable.

Lightning Discharge Counter

GENERAL ELECTRIC CO., Schenectady, N. Y. announces a new discharge counter by recording the number of lightning discharges passing through a station-type or medium-voltage distribution type lightning arresters. Only one of these counters is needed to record discharges from any phase of a three-phase arrester. For a record of the discharges from each individual phase of a three-phase arrester, three counters are necessary.

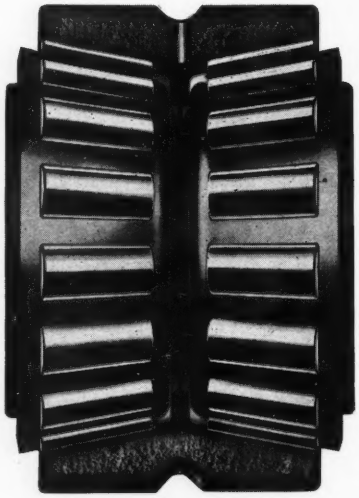
In operation, the new counter is activated when a capacitance is charged through a series and shunt arrangement of Thyrite disks whereby the energy of the lightning through the arrester actuates a solenoid-operated counter. Installed between the arrester ground terminal and ground, the instrument has no measurable effect on the protective characteristics or protection level of the arrester.

The counter mechanism is enclosed in a case similar to that used for a standard socket-type watthour meter, having a glass cover with a locking sealing ring. Each unit comes equipped with mounting bracket and a terminal for cable connection.

Roller Bearing

THE TIMKEN ROLLER BEARING CO., Canton, O., has recently released a modification in the design of the standard NA type, or non-adjustable, Timken roller bearing. Made up of a double row outer race or cup and two single row inner races or cones, it is especially adapted to serve as a sheave bearing.

Front cone faces are slotted and chamfered as shown to provide an entrance for lubricant to within the bearings. This feature is particularly advantageous in multiple sheave blocks where it is required that the bearings be lubricated through the pin which is stationary.



The problem of sealing the bearing chamber has been greatly simplified by extending the length of the large cone rib and creating a surface concentric with the shaft and sheave bore on which a seal may be run. These seals have the same O.D. as the cup and are pressed into the sheave bore and thus are used to hold the bearing together during assembly.

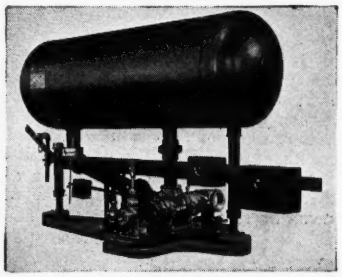
The bearings are designed to a minimum width and with an I.D. large in relation to its O.D. and also with a maximum radial and thrust capacity for the space occupied.

Removing Silica From Feedwater

AS THE culmination of research extending over a period of several years, The Permutit Co., New York, N. Y., announces that it has perfected a commercial process for silica removal, thus preventing silica scale deposits in steam boiler, superheaters and turbines. The process makes use of the silica-absorbing property of metallic oxide sludges. The water being treated is brought into the most intimate contact with high concentrations of sludge, thus assuring maximum silica removal. Operating costs are said to be low and soluble by-products are not formed, so the total dissolved solids in the feedwater is not increased but is usually reduced. The process is now in successful use. It can be used in connection with both hot and cold lime soda processes of water softening and is adaptable to either new or existing equipment.

Boiler Feeding and Deaerating Systems

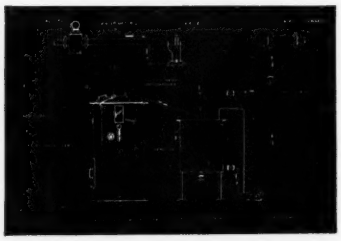
W. M. ACKER Organization, Inc., Cleveland, Ohio, announces a new automatic system for steam drainage and boiler feeding which has the ability to deaerate water fed to boilers, and is effective in the liberation of oxygen and non-condensable gases. In the design of the Acker Equalizer, the rocker section bears the brunt of mechanical operation.



The naval bronze female trunnion receives direct support from a bearing unit composed of two split bearings cast integral and located in the center of the rocker section. No weight rests on the packing. Male steam end and water end are bolted independently to a heavy bridged base which holds all elements in rigid alignment.

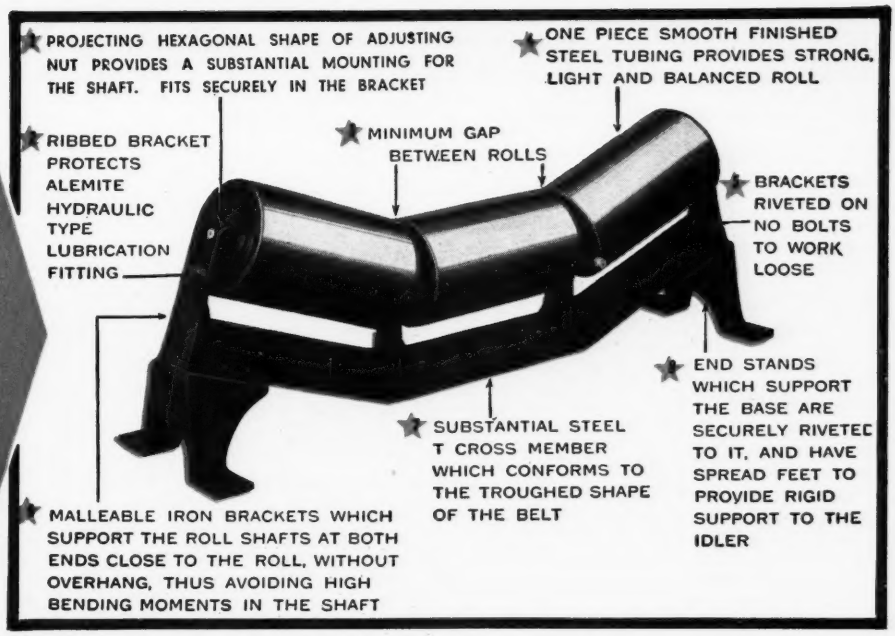
Proportioning Equipment for Corrosive Fluids

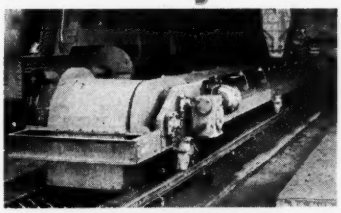
THE COCHRANE Air-actuated Proportioner made by the Cochrane Corp., 17th and Allegheny Ave., Philadelphia, Pa., is designed especially for accurately feeding sulphuric acid in conditioning boiler feedwater. A contact meter in series with a cycle controller operates an air com-



pressor inside the proportioner shell when a predetermined flow is reached. The acid is measured into the dilution tank to which dilution water is proportioned by a simple but accurate mechanism that prevents abnormal chemical concentration, either too high or too low. A special feed-line provides proper introduction of diluted acid or other fluid into the main flow.

THIS *is where* BELT CONVEYOR ECONOMY *Begins!*


PROJECTING HEXAGONAL SHAPE OF ADJUSTING NUT PROVIDES A SUBSTANTIAL MOUNTING FOR THE SHAFT. FITS SECURELY IN THE BRACKET
ONE PIECE SMOOTH FINISHED STEEL TUBING PROVIDES STRONG, LIGHT AND BALANCED ROLL
RIBBED BRACKET PROTECTS ALEMITE HYDRAULIC TYPE LUBRICATION FITTING
MINIMUM GAP BETWEEN ROLLS
BRACKETS RIVETED ON NO BOLTS TO WORK LOOSE
END STANDS WHICH SUPPORT THE BASE ARE SECURELY RIVETED TO IT, AND HAVE SPREAD FEET TO PROVIDE RIGID SUPPORT TO THE IDLER
SUBSTANTIAL STEEL T CROSS MEMBER WHICH CONFORMS TO THE TROUGHED SHAPE OF THE BELT
MALLEABLE IRON BRACKETS WHICH SUPPORT THE ROLL SHAFTS AT BOTH ENDS CLOSE TO THE ROLL, WITHOUT OVERHANG, THUS AVOIDING HIGH BENDING MOMENTS IN THE SHAFT



A motor propelled shuttle belt conveyor used to distribute coal within bunker. Travel controls may be set so that the entire conveyor assembly will move back and forth automatically, for uniform distribution. The conveyor may also be spotted for stationary discharge.

Link-Belt self-aligning idlers automatically train the belt, regardless of speed or loading conditions, and without damage to the belt. Pivotal mounting at the center of the idler permits a limited swing, thus changing the angle of the self-aligning idler with respect to the centerline of the conveyor and causing the belt to return to normal position whenever deflected.

• Dependability in a belt conveyor installation rests principally with the troughing and return idlers. They are the heart of the equipment—the "roadbed" for the belt.

Link-Belt engineers pioneered in the development of anti-friction belt conveyor idlers, with bearings enclosed within the roll, operating in a grease reservoir and protected from grit and dirt by labyrinth grease seals. They have constantly developed this fundamental design — improved the grease seal, bearing adjustment, shaft mounting and other parts.

Handles Many Materials

Today, Link-Belt designs offer the best in belt conveyor equipment for handling a wide range of materials at high and low capacities, with low power and maintenance cost and maximum belt life. These are reasons why you read of so many case histories of Link-Belt belt conveyor economy.

A Complete Line

Link-Belt makes a complete line of anti-friction idlers, with steel rolls, for light, medium, and heavy duty, as well as of cast iron, brass and other metals, to meet specific conditions.

New Developments

A more recent Link-Belt development is the positive self-aligning idler for automatically maintaining the proper position of the belt, without injury to its edges. We also make rubber-covered conveyor rolls for heavy-duty service at loading points, and a self-guiding belt conveyor system which occupies minimum headroom, yet embodies all features for positive belt alignment.

Engineering Service

Get information now on better belt conveyor equipment—whether for modernization or new installation needs. Write to our nearest office.

LINK-BELT COMPANY, *Plants at* Chicago, Indianapolis, Philadelphia, Atlanta, Dallas, San Francisco, Toronto. Offices and warehouses in principal cities. 8105-11

LINK-BELT

A TYPE FOR EVERY SERVICE

BELT CONVEYOR EQUIPMENT

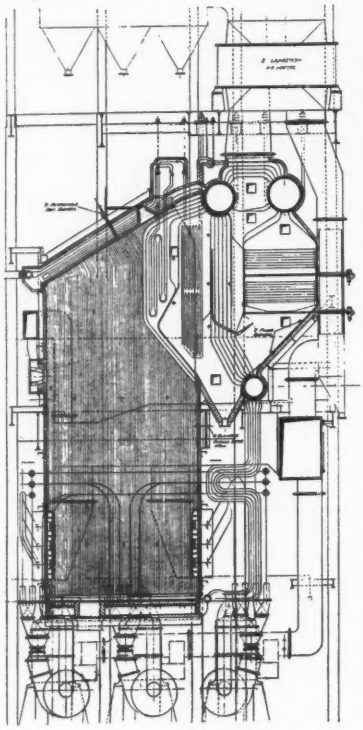
IDLERS • TRIPPERS • BELTS • PULLEYS • BEARINGS • TAKE-UPS • DRIVES

New Orders Mark Plant Expansion

Million Pound Per Hr. Top For Sherman Creek

The latest extension in the construction program of the Consolidated Edison Company of New York, Inc., is the topping of the Sherman Creek Station, located at 201st Street and Harlem River.

This topping installation will consist of a million lb. per hr. steam generating unit, designed for 1775 lb. pressure and supplying steam at 1600 lb., 955 F. to a 50,000-kw., 3600-r.p.m. turbine-generator exhausting to the present 200-lb. station header.



Cross Section of Sherman Creek Boiler

The steam generating unit, for which contract was let to Combustion Engineering Company on August 26, will be of three-drum bent-tube type with Elesco superheater and economizer, two Ljungstrom regenerative air preheaters and a steam washer in the steam drum. It will be tangentially fired with pulverized coal from three C-E Raymond bowl mills and have a continuous slag-drip furnace bottom. In addition to the twelve coal burners, three in each corner, there will be two oil burners in each corner, between the coal burners, and four horizontal oil burners, located in the front upper wall. The latter are for maintaining performance with oil comparable to that when burning coal.

Plain bifurcated tubes will be employed for the front, rear and side furnace walls and the roof and bottom will have fin tubes. The unit itself will occupy a space of 49x53 ft. between building columns and will extend approximately 90 ft. to the top of the air heaters, the mills being located at the basement level.

New Westinghouse Orders

The Consolidated Edison Co. of New York has placed an order with the Westinghouse Electric and Mfg. Co. for a 50,000-kw. hydrogen-cooled superposed turbine generator to be installed in their Sherman Creek Station, New York City. The 3600 r.p.m. turbine is designed for 1500 lb. psi, 950 deg. F. inlet steam conditions and exhausts to the present low pressure system at 200 psi.

Westinghouse also received a contract to build a 65,000-kw. turbine-generator for the City of Los Angeles, California. The unit, to be installed in the Wilmington Station and costing over one million dollars, will be the largest 3600 r.p.m. condensing turbine that has been built. Steam conditions are 850 psi, 900 deg. F. and 29 in. Hg. vacuum.

The turbine will provide firm reserve power for the electricity received from the hydroelectric development at Boulder Dam. It will normally carry a load of 5000-kw., being ready at any instant to pick up and carry a full load of 6500-kw. should there be an outage along the Boulder Dam line.

Big U. S. Contract to Allis-Chalmers

Allis-Chalmers Mfg. Co., has been awarded contracts for one hydraulic turbine for the Pickwick Landing Dam project and two hydraulic turbines and two generators for the Wilson Dam project, which in the aggregate will amount to approximately $1,660,000.

The Pickwick Landing hydraulic turbine is rated at 48,000 hp. at 81.8 r.p.m. with a 43 foot head. This order makes the Pickwick Landing Dam project 100% equipped with Allis-Chalmers hydraulic turbines.

The two hydraulic turbines for which this contract calls are each rated at 35,000 hp. at 100 r.p.m. with a head of 92 ft. The two generators are 28,000 kv-a., 13,800 volts at 100 r.p.m. and are of the so-called umbrella type.

Another order awarded to Allis-Chalmers was a $550,000 contract by the Sanitary District of Chicago, to build the three largest turbine-driven blowers for sewage aeration in the world.

These large blowers each will have a capacity of 115,000 cu. ft. per minute at 8½ lb. gage. Each will be direct connected to a 5200 hp. steam turbine, and each will have its own condensing unit, connecting piping and air check valves. This installation will treat about 660,000,000 gallons of sewage per day.

New Orders Received by G. E.

Orders for turbine-generator sets, totaling 102,000 kilowatts and costing more than $2,000,000, have been placed with the General Electric Company by two eastern utilities. The units ordered are a 52,000-kw. unit for Consolidated Gas & Electric Co. of Baltimore and a 50,000-kw. unit for Potomac Electric Power Co., of Washington, D. C.

The turbine-generator for Consolidated Gas & Electric of Baltimore is a duplicate of another now being built in the General Electric shops and scheduled for shipment in Januarv, 1941. In addition, a 25,000-kw. G-E Topping unit which will exhaust to two older 20,000-kw. units is now being installed at the Westport station. The two 52,000-kw. turbines will be 3600-r.p.m., tandem-compound, double-flow units with steam conditions of 850 psi and temperature of 900 F., one in. absolute back pressure. Generators will be hydrogen cooled.

The Potomac Electric Power Co. turbine, to be installed in the Buzzard Point Station at Washington, D. C., will also be a duplicate of a General Electric unit shipped to this station in July and now being installed. Both are 50,000-kw., 1800-r.p.m., single-casing, single-flow turbines, having steam conditions of 650 psi. and 900 F. temperature, 1 in. absolute back pressure.

New Unit for Burlington

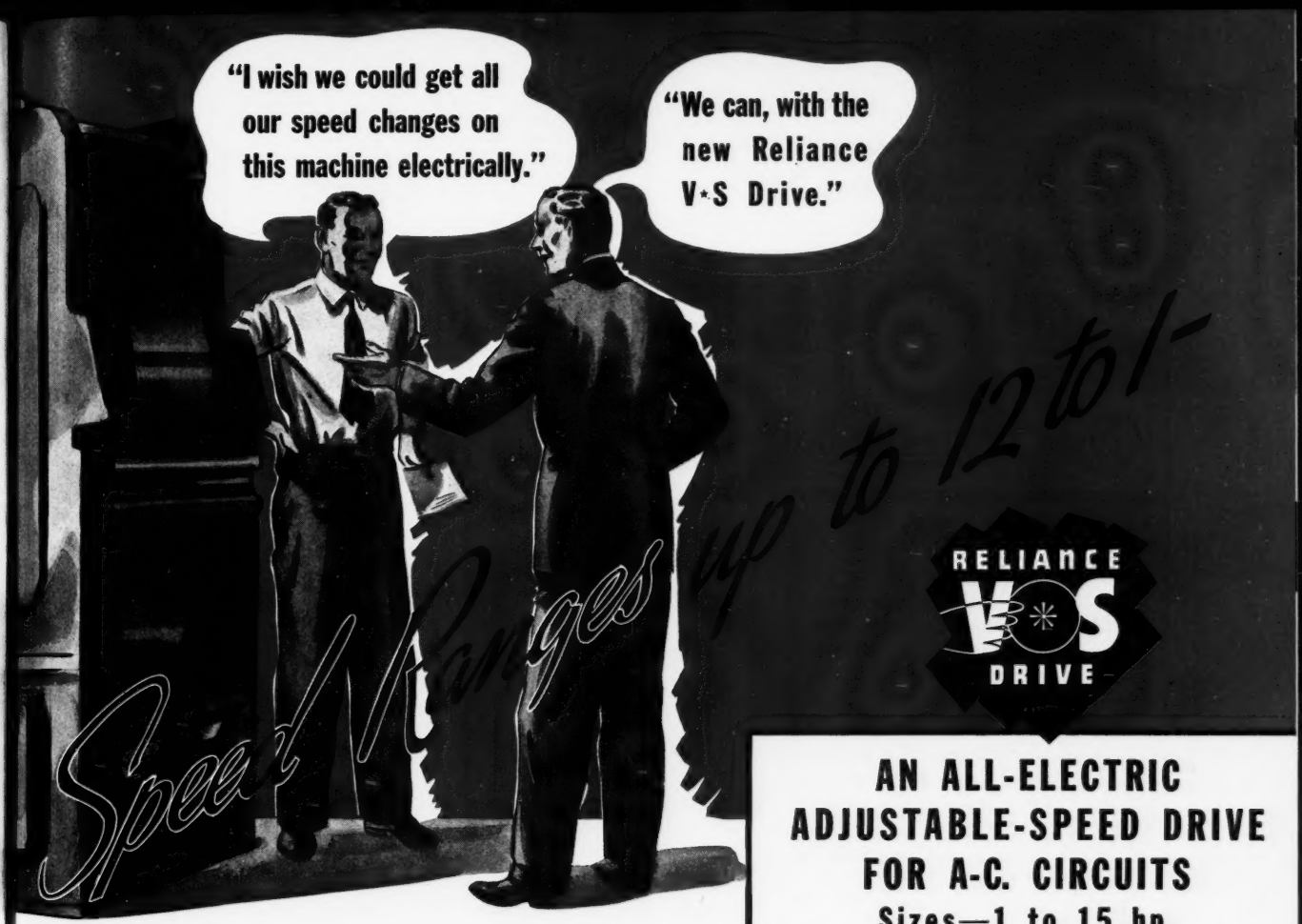
In continuation of the expansion program at its Burlington generating station, Public Service Electric and Gas Co. has placed an order for another 100,000-kw. generating unit, which, with accompanying plant and transmission facilities, will cost $11,500,000 and will be ready for operation in 1943. This, in addition to the $12,000,000 initial step in the building program started at this station last fall which includes the installation of a similar 100,000-kw. generator, will increase the capacity of the station from its present 55,000-kw. to 255,000-kw.

The turbine generator just ordered for the Burlington generating station and the one now being installed there are of the cross-compound condensing type. Each will consist of two 50,000-kw. elements, one high-pressure and one low-pressure, and will operate at approximately 1250 psi and 950 deg. F. The speed of machines will be 3600 r.p.m.

G. E. Unit for T. V. A.

As part of the program to build up the Tennessee Valley as a national defense industrial section, three large General Electric waterwheel generators, costing more than $1,200 000, have been ordered by the Tennessee Valley Authority for the Cherokee Dam power house. Construction of this dam, which is located on the Holston River, near Jefferson City, Tennessee, will be rushed to provide power for new national defense industries in this section.

100,000 kv-a. will be produced by the new generators. Each rated 33,333-kv-a., 13,800 v., and 94.7 r.p.m., the units will be furnished with G-E exciters and air coolers.


"I wish we could get all our speed changes on this machine electrically."
"We can, with the new Reliance V•S Drive."
Speed Ranges up to 12 to 1
RELIANCE V•S DRIVE

AN ALL-ELECTRIC ADJUSTABLE-SPEED DRIVE FOR A-C. CIRCUITS

Sizes—1 to 15 hp.

THIS new drive takes full advantage of the fact that the electric motor is not only a power unit but also provides within itself a simple method of speed changing. It enables you to get power closer to the place where power is needed and to eliminate intermediate speed-changing devices. It takes humps and bulges out of your machines —aids efficient, streamlined design.

Starting and stopping are as simple as ringing a door bell; speed changing easier than turning a doorknob. And there are no limitations on convenience. The start-stop button and speed changer can be placed anywhere that a wire can be run. Both are so compact that they can be grouped with other control elements for the machine.

And these features help production, too—quick stopping, reversing, safe speeds for threading and inching, ample starting torque with smooth acceleration, stopping and starting without interfering with the speed setting.

Ask for Bulletin 307, which gives details

A Proven Principle of Speed Control

The Reliance V•S Drive employs a proven principle of speed control long used for large units. The "packaged" Speed Control Unit now makes available the smaller sizes for applications where cost has formerly prohibited their use.

Reliance Electric & Engineering Co.
1062 Ivanhoe Road Cleveland, Ohio

Birmingham, Boston, Buffalo, Chicago, Cincinnati, Detroit, Greenville (S. C.), Los Angeles, New York, Philadelphia, Pittsburgh, Portland (Ore.), St. Louis, San Francisco, Syracuse (N. Y.), and other principal cities.

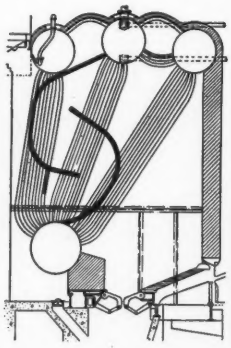
RELIANCE A-C D-C MOTORS

You are assured of

MORE POWER . . .
BETTER BOILER OPERATION

with

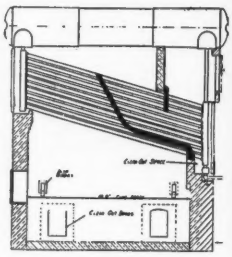
Enco Streamline Baffles



because:

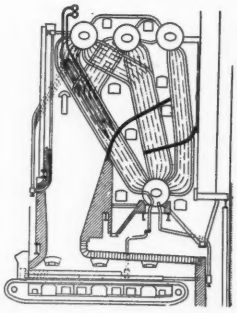
. . . they are *designed* to insure better heat distribution, lower flue gas temperatures and higher efficiencies, and the design is based on *results already achieved.*

. . . they are *flexible.* By streamlined and curved construction, it is possible to meet various tube and superheater arrangements and obtain maximum rate of heat transfer.

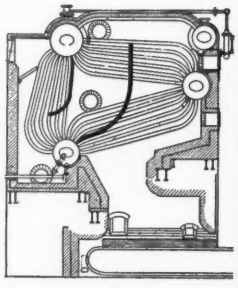


. . . surfaces are *smoothly curved.* Enco Streamlined Baffles, by eliminating angle joints, eliminate dead gas pockets and eddy currents. By so doing they decrease draft loss and make it easier for soot blowers to do their work more effectively.

. . . they are *gas tight.* Construction work is done by experienced mechanics who are specialists in building baffle walls exactly to Enco specifications. Provision is made in both design and construction for removal of tubes with the least possible disturbance of baffle walls.



. . . *Enco materials are carefully selected.* Only the finest obtainable refractories are used for Enco tile and plastics. Special processing is employed to insure resistance to high temperatures and maximum life in service.



Ask for Bulletin BW-40

containing valuable information. Detailed engineering data on modern baffle wall practice for all types of water tube boilers—FREE on request.

THE ENGINEER COMPANY

75 West St., New York, N. Y.

News from the Field

Promotions of Leeds & Northrup Executives

W. RICHISON SCHOFIELD, formerly chief engineer of Leeds & Northrup Company, Philadelphia, Pa., has recently been appointed director of engineering. John W. Harsch, assistant chief engineer, has been advanced to chief engineer, and Mr. Harsch's former position has been filled by the promotion of John F. Quereau.

W. Richison Schofield,

John W. Harsch, Chief Engineer

Mr. Schoefield joined Leeds & Northrup in 1916 and since 1928 has held the position of chief engineer. An authority in pyrometry and automatic control, he holds important patents in these fields. He is an active member of the A.S.M.E. Committee on Industrial Instruments and Regulators and the A.I.E.E. Committee on Electrochemistry and Electrometallurgy.

Mr. Harsch joined Leeds & Northrup in 1924 and in 1928 became assistant chief engineer. He is largely responsible for the design of the Homo tempering and Homocarg carburizing furnaces; is vice chairman of the Philadelphia Chapter of A.S.M., and as a member of A.S.T.M. is chairman of the Sub Committee on Life Testing Nickel-Chrome Resistor Materials.

Mr. Quereau has been with Leeds & Northrup since 1929, is the inventor of a number of thermocouple and resistance thermometer devices, and an active member of A.S.M.

THE SINTES SALES Engineering Co., New Orleans, La. has been appointed representative for The Universal Gear Corp. in Louisiana, southern part of Mississippi and the Mobile section of Alabama.

WILLIAM L. FEWSMITH, Manager of Publicity and Advertising for Robins Conveying Belt Co., Passaic, N. J., died after a brief illness while on vacation at Port Carling, Ont., Canada, August 15, at the age of 61. Mr. Fewsmith joined the Robins Conveying Belt Co. in 1913 as a Civil Engineer and had been continuously employed both in the capacity of Civil and Mechanical Engineer until 1924 when he was appointed head of the Publicity and Advertising Department.

CHRISTIAN WILSON, JR., sales representative, formerly of the YARWAY New York Office, is now located in the Pittsburgh territory, with headquarters at Yarnall-Waring Co., Wabash Building, Pittsburgh, Pa.

A MINUTE...OR TWO...AND YOU'RE THROUGH

1

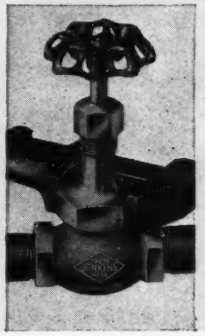
DISC HOLDERS READY LOADED

Keep a few extra disc holders on hand already loaded with the Jenkins Discs recommended for your services. Then you are ready to make replacements in the minimum time because disc holders are reloaded in spare time.

2

BONNET QUICKLY REMOVED

Apply a wrench to the husky one-piece bonnet and unscrew. By raising the spindle a turn or two you will prevent the disc holder from falling off the spindle.



3

SLIP OFF OLD— SLIP ON NEW

Now turn the spindle all the way down and the disc holder will slip off in your hand. Slip on the holder containing the new disc—return the trimming to the body, for "good as new" service.

QUICK, SURE WAY TO GET DROP-TIGHT SERVICE— *Jenkins* 106-A *Valves*

Speed counts in modern industry. Minutes wasted are dollars lost. Making repairs in minimum time is tremendously important, too.

That's why we ask "when a valve disc must be replaced, do you figure on shutting the line down for a few minutes or for an hour or more?"

With Jenkins 106A Valves, it's as simple as this . . . Just unscrew the body, lift out the trimming and the job's half done. Then slip off the disc holder, slip on a holder containing a new disc and the valve is ready for another long span of trouble-free service.

This is the experience of engineers in thousands of the country's plants, to whom Jenkins Renewable Disc Valves and Discs are standard.

Of course, you require and actually use renewable disc valves—for economy—for versatility—for ease of maintenance. With Jenkins 106A "Family" you get all these advantages *plus* the convenience of interchangeable parts. Check the cut-away views below that explain the variety of valve combinations this unique "Family" make possible. Ask your local distributor about them or write for Bulletin No. 189.

JENKINS BROS., 80 White Street, New York, N. Y.; Bridgeport, Conn.; Atlanta, Ga.; Boston, Mass.; Philadelphia, Pa.; Chicago, Ill.; Houston, Texas. Jenkins Bros., Ltd., Montreal; London.

Plus—

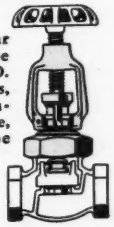
VALVE COMBINATIONS through INTERCHANGEABLE PARTS for 90% of your needs

GLOBE OR ANGLE BODY
Screwed or Flanged

Standard 106-A trimming is exactly the same for Globe or Angle body, screwed or flanged.

with OUTSIDE SCREW AND YOKE

Similarly all four body styles can be fitted with one O. S. & Y. trim. Thus, if service conditions necessitate, the valve can be quickly converted merely by changing the trim.



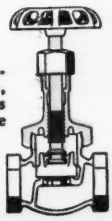
for THROTTLING SERVICE

For close control, simply remove the nut which holds the disc in the disc holder and replace with this throttling nut Fig. 344.

For use on Fig. 106-A to 109-A inclusive. Also 106-AY to 109-AY.

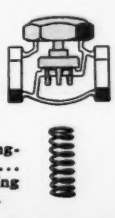
for QUICK OPENING

For quicker opening and closing, substitute this bonnet and spindle from Fig. 942, in which threads are pitched more sharply.



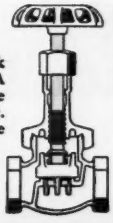
for LIFT CHECKS

Globe and Angle bodies can be fitted with one trimming—Cap, Disc Holder and Disc Holder Nut from Fig. 117-A. For Spring-loaded services . . . simply add Spring from Fig. 655-A.



for STOP AND CHECK

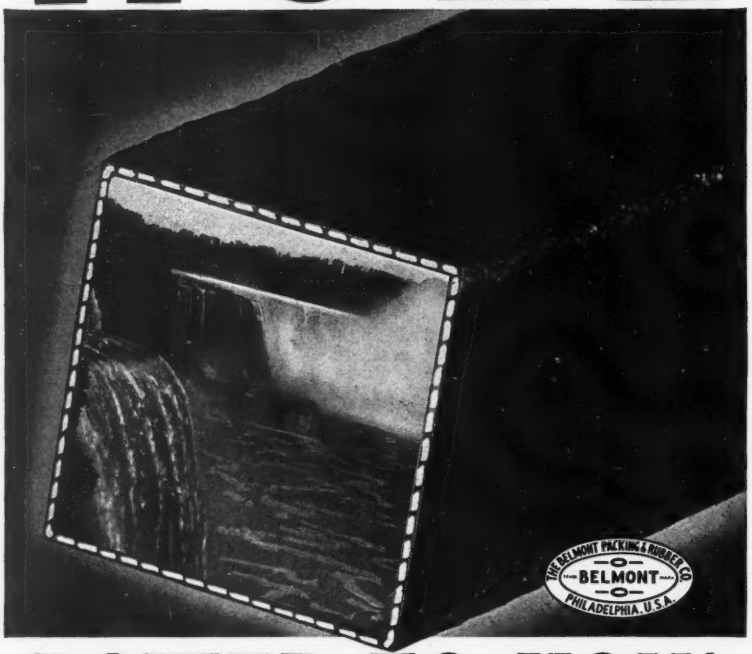
For Stop and Check service, use 106-A trim but substitute Spindle from Fig. 630-A and replace disc nut with the check valve disc nut.



DISCS MADE BY JENKINS

For all these valves, pick the disc *exactly* compounded for the pressure, temperature and fluid to be handled.

MORE



POWER TO YOU!

PACK WITH BELMONT

No matter how small—power leaks are costly. That's why Belmont takes such minute care in the construction of Belmont Hydraulic Packings.

Take Belmont 319, for example. Only the finest quality rubber friction duck is used. The hollow center, which was originated by Belmont, provides a point of least resistance for contraction and expansion. This also serves to keep friction at a minimum, since the packing tends to "breathe" towards the "hole," as varying pressures are exerted upon it in the stuffing box.

This type of construction care is not an isolated example. It's the rule for the entire Belmont Line. See for yourself. A request on your company letterhead will bring the new 1940 edition of the Belmont Catalog to you absolutely free.

SUGGESTED PACKINGS FOR WATER SERVICE

BELMONT 319

Hollow Center Packing

Made of finest quality closely woven rubber frictioned duck, wrapped on itself and moulded to size. Supplied in packing space sizes ¼" and over; lubricated and graphited unless otherwise specified.

BELMONT 9

Special Hydraulic Packing

Made of Long Line best quality Flax stitched with strong linen thread into a moulded rubber and duck channel. The double combination of casing and flax makes two packings in one against the wearing surface. Supplied lubricated and graphited unless otherwise ordered, in all packing space sizes from ¼" upward.

THERE'S A BELMONT PACKING FOR EVERY SERVICE

BELMONT

PACKINGS

THE BELMONT PACKING & RUBBER COMPANY

BUTLER AND SEPVIVA STREETS • PHILADELPHIA, PA.

G. E. To Build Gas Turbines

ORDERS FOR two gas-driven turbines, the first to be built for sale by the company, have been received by the General Electric Co. One unit will be used by a California oil refinery, and the other by a Texas refinery.

Details of the machines cannot be revealed since the catalytic processes in which they will be involved are secret. Fundamentally, however, they will be similar to usual steam turbines except that they will operate on high-temperature by-product gases which would otherwise be wasted. The units will be rated 3250 hp. and 400 hp.

South Carolina Public Service Authority to Award Power Plant Contract

THE SOUTH CAROLINA PUBLIC SERVICE AUTHORITY, Charleston, S. C., has low bid from the Central Engineering Co., Davenport, Iowa, at $360,730 for construction of station superstructure at Pinopolis hydroelectric power station, Santee-Cooper Project, including lock house, elevator house and general utilities building, and award is scheduled to be made at early date. Another low bid has been made by C. M. Guest Co., Anderson, S. C., at $72,305, for furnishing and installing certain miscellaneous power equipment, including oil and water pumps, air compressors, oil purifiers, etc., with piping systems and valves. The development is situated about 32 miles north of Charleston and will be completed in 1941. Harza Engineering Co., 27 Cumberland Street, Charleston, and 205 West Wacker Drive, Chicago, Ill., is consulting engineer for project.

Foxboro Appoints Bumstead-Woolford

C. E. SULLIVAN, Vice President and Sales Manager of The Foxboro Co., Foxboro, Mass., announces the appointment of Bumstead-Woolford as exclusive sales representatives for the Oregon and Washington territory. The arrangement became effective as of August 1.

The firm of Bumstead-Woolford was recently formed by Mr. Dale Bumstead and Mr. O. H. Woolford, both of whom have wide acquaintance and long records of experience in fields of industrial engineering. In addition to the Foxboro line, they will represent a number of other nationally known and non-competitive industrial equipment manufacturers. The new firm has established its head office at 1411 Fourth Avenue, Seattle, and has also taken over the former Foxboro Co. office at Portland, at 301 Lewis Building. Mr. E. E. Stephens, an experienced instrument man, and Mr. C. H. Graham who, for the past four years has been the Foxboro sales engineer in the Portland district, have joined the Bumstead-Woolford staff.

Bumstead-Woolford will work independently but in close cooperation with The Foxboro Co.'s own organization on the Pacific Coast, under the direction of Mr. H. B. Brooks, Division Sales Manager, located in San Francisco, Cal.

THE WELLMAN ENGINEERING CO., Cleveland, O., recently announced the election of Dr. James Campbell Hodge to the position of Vice President and member of the board.

(News continued on page 122)

PRODUCTION BLOCKED BY A SLUG OF WATER

A Case Story

SOLVED WITH PREVENTIVE MAINTENANCE

TOMORROW—hundreds of plants may face a case like this: A midwestern manufacturer was suddenly swamped with orders. The plant had a good reserve capacity—yet, push as the management did, it failed to get the output needed.

The boilers and machinery were in excellent shape—but the steam lines were sluggish. The ailment was a common one—a condition that's quickly corrected with proper equipment.

That's how Preventive Maintenance entered the case. For, it's the only sure way of solving piping problems and keeping them solved. This simple technique guides you in installing and caring for pipe lines correctly; it helps you choose the right valves and fittings for every service.

This case shows how Preventive Maintenance works. While the management raved, the Superintendent put his hands on the trouble. The machines were not only slow in heating up, but they wouldn't stay hot. The drainage system was inefficient—it failed to remove condensate rapidly enough to keep the machines at maximum temperature.

The backlog of orders haunted the Superintendent. He saw that more than ordinary maintenance was necessary. "The Crane man," he said as he reached for a phone, "will help us solve this quickly and surely."

The two men reviewed the situation. To run the machines at top speed meant keeping them at maximum temperature. Condensate would have to be drained as rapidly as it formed. The correct solution, as Preventive Maintenance counseled, involved redesigning of the drainage system, and installing a Crane Inverted Float Trap on each machine.

Results: The condensate trouble was banished. Production was immediately doubled. Another user of piping knows the value of Preventive Maintenance. Also, knows that the best way to get most from piping maintenance dollars is to call in the Crane Man. Because, backed by Crane experience and the great Crane line of valves and fittings, he offers the means of a successful Preventive Maintenance program.

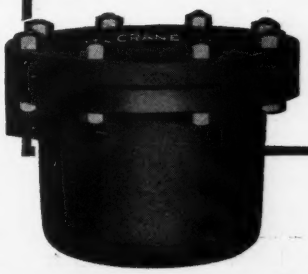
This case comes from the personal experience of W.F.C. —a Crane Representative in the Kansas City Branch

YOUR STEAM LINES KEPT HOT AND DRY WITH CRANE TRAPS

You are not getting the maximum heat and power from steam if your lines are not properly drained. You are straining the piping, shortening the life of valves, exposing steam-operated equipment to serious damage when condensate is not removed.

In steam lines up to 600 pounds pressure, the wasteful and damaging effects of condensate are completely eliminated with Crane Inverted Open Float Steam Traps. These sturdy, simple, and low-cost traps will pay for themselves many times over. Once installed they require minimum attention—yet, automatically, stop steam waste, step up efficiency.

For pressures up to 200 pounds, the Crane line of No. 981 traps will give maximum protection against condensate troubles.

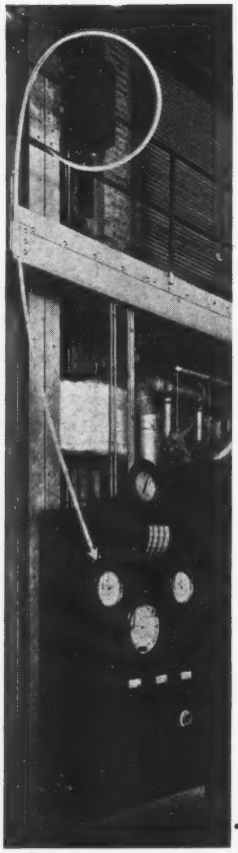


CRANE

CRANE CO., GENERAL OFFICES: 836 S. MICHIGAN AVE., CHICAGO

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

FIFTH COLUMN IN BOILER ROOM



Installation of Hays Combustion Meter in Plant of Mid-West Implement Manufacturer—analyzing section mounted close to sampling point; indicating-recording section in easy range of operator.

The Enemy within!

He's working there in your boiler room just as positively as your fireman is working there. He's working against the efforts of your fireman to produce steam economically. Like other fifth columnists, his presence is often unsuspected. His name is EXCESS AIR and he may be wasting as much as a quarter of your fuel. Run this fifth columnist out of your boiler room! Protect your power plant against costly waste and inefficiency, by installing a Hays Combustion Meter. This modern weapon against high operating costs detects the presence of Excess Air and makes possible adjustments in the air supply that will secure the most efficient and most economical combustion possible to obtain with your equipment.

"How To Save 10% to 25% of Your Steam Plant Fuel"

Get the whole story of Excess Air—mail this coupon for new free booklet "How to Save 10% to 25% of Your Steam Plant Fuel".

INDIVIDUAL.....

FIRM NAME.....

ADDRESS.....

P.P.E.

The HAYS CORPORATION

COMBUSTION INSTRUMENTS AND CONTROLS

MICHIGAN CITY, INDIANA, U.S.A.

Let Us Know About It

If you have a problem on the installation or operation of power equipment, or if we can be helpful in securing latest catalogs or information from manufacturers, let us know about it. There is no charge for this service. Write Reader Service Department, POWER PLANT ENGINEERING.

Helpful Bulletins

BOILER PLANT EQUIPMENT

1 Boilers—Babcock & Wilcox Co. Bulletin No. G-28 describes Design 32 cross-drum, straight-tube, sectional header unit for pressures of 250 lbs. or less, with heating surface from 1000 to 6000 sq. ft.

2 Stokers—Detroit Stoker Co. 12-page bulletin No. 550 covers complete line of Detroit stokers, including unistoker, Lostoker, triple-retort stoker, Rotostoker, and multiple-retort stoker.

3 Blow-down Separator — Illustrated Bulletin No. B-1 describes the Wilson blow-down separator. This boiler device is designed to muffle the discharge, separate the water and flash steam, discharge the steam to atmosphere, drain the water to sewer or tank. Wilson Engineering Corp.

4 Boiler—A 14-page bulletin gives the details of construction of the forged steel sectional header type boiler. Several drawings of representative installations of this type of boiler are included in the bulletin. Henry Vogt Machine Co., Inc.

5 Dust Collectors—Prat-Daniel Corp. 8-page catalog No. 108 covers Thermix tubular dust collectors. Practical advantages of design explained, construction details shown, and suggested layout with explanatory remarks presented. Brief listing of other types included.

6 Boiler Feed System — New illustrated Bulletin WP-330 describes exclusive features of Westco Automatic Boiler Feed System. It uses no steam, is inexpensive to operate, automatically returns all condensate to the boiler. Micro-Westco, Inc.

7 Blow-Off System—Interesting data on how to modernize and economize with the Cochrane blow-off system constructed for service under high steam pressure may be had by checking this item. Ask for publication 2770. Cochrane Corp.

8 Feed Water Heaters—New illustrated Bulletin S-18-D tells how preheating and deaerating of boiler feed water promotes greater fuel economy, lessens trouble from lime and scale. The Swartwout Co.

9 Coal and Ashes Handling—"Solving the Problem of Coal and Ashes Handling in the Power Plant" is the title of a useful 32-page book No. 1510 issued by Link-Belt Co. Copiously illustrated, this handbook presents practical suggestions for cutting handling costs by means of elevating and conveying equipment, coal crushers, etc.

10 Spreader Stoker—New 20-page catalog describes Iron Fireman Pneumatic Spreader Stokers which help retain a uniform steam pressure despite wide fluctuations in demand. Iron Fireman Mfg. Co.

11 Furnace Refractory—A 36-page illustrated booklet, "Carbofrax In Boiler Furnaces," contains valuable data on application and performance of silicon carbide refractory in a wide variety of boiler furnaces. The Carborundum Co.

ELECTRICAL EQUIPMENT

12 Synchronous Motors — General Electric Co. GEA-246F describes "7500 series" high-speed synchronous motors, Type TS, 3-phase, and Type QS, 2-phase, including description of form B1 stator construction and form E1 stator specifications.

HELPFUL BULLETINS

Many useful engineering bulletins and catalogs are offered in the news and advertising pages of POWER PLANT ENGINEERING. For your convenience we publish the following summary of such literature mentioned in this and recent issues. To obtain copies of these bulletins and catalogs described simply indicate the paragraph numbers on the card below, detach and mail.

13 Panelboards — Westinghouse Electric & Mfg. Co., 4-page leaflet presents descriptions of Nofuze panelboards, with advantages and conveniences of several types. Several panel arrangements included.

14 Low-Speed Generators—The Electric Power Department of Elliott Co., announces a new Bulletin L-9 entitled "Low-Speed Alternating-Current Generators." This 16-page publication describes and illustrates the construction of Elliott generators for this type of service, with installation views of generators driven by various makes of Diesel engines.

15 Transformers—Bulletin GEA-2736 describes savings possible with Pyranol transformers for factories, office buildings, hospitals, and other buildings. General Electric Co.

FANS, PUMPS AND COMPRESSORS

16 Pumps—Warren Steam Pump Co., Inc., 20-page catalog covers complete line of centrifugal, simple and simple and duplex pistons, and plunger pumps. Also includes vacuum pumps.

17 Compressors—Pennsylvania Pump & Compressor Co. Bulletin No. 184 describes single-stage roller-bearing compressor. Regulation, control, and operation included, with cross-sectional drawing illustrating important parts.

18 Pumps Valves and Silent Check Valves are illustrated and described in a new 16-page booklet issued by the Combination Pump Valve Co.

19 Pumps—An automatic priming system for centrifugal pumps, which keeps the pump always filled with water and eliminates need for attention from operators, is described in a paper by F. S. Broadhurst, which has been reprinted and is being distributed by the De Laval Steam Turbine Co.

20 Forced Draft Fans—To gain maximum heat from coal and to provide flexibility, forced and induced draft fans are suggested for modern power plants. Bulletins 3190 and 3113-A contain performance curves, give the draft story in detail. Buffalo Forge Co.

21 Pumps—Just off the press are these three well-illustrated booklets on Fairbanks, Morse & Co. pumps. Bulletin 6930 R describes Turbine Pumps, Bulletin 6360 features Propeller Pumps and Bulletin 5710 features Angle flow Pumps.

INSTRUMENTS AND CONTROLS

22 Combustion Control—Bailey Meter Control of combustion and feed water, for insuring top capacity and continuity of service from steam generating equipment, is described in Bulletin No. 102-B. Bailey Meter Co.

23 Thermometers—Brown Instrument Co. Catalog No. 6705 covers complete line of circular-case thermometers and pressure gages, indicators, recorders and controllers, as well as self-contained and portable models.

24 Recording and Indicating Instruments—Taylor Instrument Co. 64-page catalog covers all types of recording, indicating and controlling instruments made by company. Included as service to engineers and practical men are fundamentals on rate-of-flow measurements, calculations, and glossary of terms, as well as typical sections from uniform scale charts.

25 Regulators—Northern Equipment Co. 15-page bulletin No. 429 describes Copes Flowmatic regulator, giving principle of operation, schematic drawings, and lists of specifications and users.

26 Pump Governors—Foster Engineering Co. 16-page publication (catalog 70—Bulletin 13) covers Foster governors for all services. Well illustrated in 2 colors; cut-away and line drawings show construction. Installation instructions also included.

27 Pressure Equalizers—Bulletin contains descriptive data on equalizers for protecting delicate pressure instruments from shock, chattering and premature wear. Insures accurate gage readings. Units are scientifically grooved and graduated for operation on many types of lines under highest pressures. National Engineering Products, Inc.

28 Draft and Pressure Gauges—For indicating and recording draft, pressures and differentials, new Republic indicators and recorders are described in a new 16-page Bulletin No. 801, just issued by Republic Flow Meters Co.

29 Fluid Meter — Illustrated 8-page Bulletin No. 52 describes design and application of Simplex MS meter for measuring flow of steam, water, air, gas and other fluids. Contains table for computing meter capacities. Simplex Valve and Meter Co.

30 Automatic Controllers — Bristol's 50th Anniversary Bulletin No. 547, pictures and describes automatic controllers, pyrometers, recording gauges, flow meters, and other products and services. The Bristol Co.

31 "Why Excess Air Means High Steam Costs" is the title of an interesting bulletin describing combustion meters for measuring flue gas, temperature, and furnace draft. Uses Orsat principle of volumetric measurement and chemical absorption. The Hays Corp.

32 Motor Control—"The Story of Vertical Contacts" is the title of new 24-page book of special interest to users of motor control. It pictures the development of dust-safe, dependable vertical contacts. Cutler-Hammer, Inc.

MECHANICAL TRANSMISSION

33 Flexible Couplings—Morse Chain Co. 32-page bulletin No. 57 contains engineering data, installation and operating information on entire line of Morse flexible couplings, Silent Chain couplings, Roller Chain couplings, Morflex couplings, Morflex Radial couplings and universal drive shafts.

34 V-Belts—Allis-Chalmers Mfg. Co. Revised catalog section No. 151 introduces new horsepower ratings for multiple-V-belt drives based on formula developed by Robert F. Vogt. Also provides engineering information on selection of size for horsepower ratings, speed, center distance and sheave diameters.

Indicate the literature you want on reverse side of this card. No postage needed.

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POWER PLANT ENGINEERING

53 West Jackson Boulevard

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35 **Bearing Metal Hand Book**—A 96-page book containing useful information about anti-friction metals, practical instructions for the making and operation of lined bearings for efficient and economical service. The working information and instruction data will prove useful to every plant operating man. Magnolia Metal Co.

36 **Speed Reducers**—Philadelphia Gear Works. 64-page catalog covers line of single- double- and triple-reduction herringbone speed reducers.

37 **Flexible Coupling**—Illustrated 16-page bulletin recently issued by Ajax Flexible Coupling Co. contains detailed descriptions of Ajax flexible couplings, together with all dimensions, horsepower ratings and other technical information essential to the purchase and installation of couplings.

PIPING, VALVES AND FITTINGS

38 **Welding Fittings**—Bulletin 36 supplies data on welding fittings (ells, tees, flanges, nipples, return bends, reducers, etc.) which improve pipe design and cut costs. Tables give maximum allowable working pressures, prices, dimensional data, and other necessary information. Midwest Piping & Supply Co., Inc.

39 **Impulse Steam Trap**—Bulletin T-1735 gives complete construction details, operating principles and advantages of Yarway impulse steam traps. Method of selecting the right trap is detailed, and bulletin explains how to determine steam trap efficiency. Included also is a table of the thermodynamic properties of saturated steam. Yarnall-Waring Co.

40 **Flexible Piping**—Bulletin 60 describes advantages and applications of Penflex all-metal hose for automotive use, spouts, ventilation, loose-material handling, wiring, etc. Pennsylvania Flexible Metallic Tubing Co.

41 **Steel Valves**—Powell Steel Valves available from alloy steels in all types and sizes, operating with pressures as high as 2500 lb. at 900 deg. F., are described in Catalog No. 101. The Wm. Powell Co.

42 **Steam Trap Selection**—"How To Choose A Steam Trap" is the title of a new and helpful handbook. It contains condensation rate charts, graphs and tables—short formulas for computing capacity of steam using equipment—trap sizes for unit heaters, autoclaves, header drips, jacketed kettles, etc. The V. D. Anderson Co.

43 **Condenser Tubes**—A new revised edition of the "Condenser Tube Booklet" presents latest findings and varied experiences with condenser tubes. It describes alloys that best meet particular conditions, suggests ways for preventing and correcting tube troubles. Scovill Manufacturing Co.

44 **Steam Specialties**—Catalog 500 issued by J. E. Lonergan Co., describes safety valves, gauges for indicating steam, air, water or other pressures, whistles, oil cups, water gauges and gauge cocks. Includes dimensions, weights and other data.

45 **Steam Traps**—Bulletin No. 32 describes float-thermostatic steam traps for low, medium, and high pressures up to a maximum of 200 lb. A mechanical trap suitable for use in connection with engines, turbines, pumps, unit heaters, water generators, etc. Equipped with thermostatic air bypass for automatic air removal. Sarco Co., Inc.

46 **Pressure Reducing Valve**—Bulletin 100-A describes Davis No. 15 pressure reducing valve for vapor heating systems. Sizes from ½ to 14". Construction features, prices, sizes and diagrammatic views given. Davis Regulator Co.

47 **Corrosion Resistant Valves**—New Catalog No. 312 describes Crane Corrosion-Resistant valves and fittings. Authoritative colored "stop and go" chart indicates degree of suitability of each alloy for specific services. Crane Co.

PRIME MOVERS

48 **Steam Engine**—Bulletin A, issued by Skinner Engine Co., presents seven case studies of plants which reduced power costs with Universal unaflow engines under guaranteed saving contract.

49 **Diesel Engines**—New illustrated 16-page bulletin No. 130 describes Lister-Blackstone Diesel engines and Powr-Pak Diesel-electric units. This useful bulletin includes data and performance charts on Diesel installations in factories, hospitals, stores, etc. Lister-Blackstone, Inc.

50 **Turbine-Generator**—Elliott Co. 32-page illustrated booklet H-10 describes steam turbine-generators of condensing, non-condensing, and extraction types. Also discusses arrangement of turbine-generator-condenser unit, shows sectional views of three types mentioned and includes charts giving quick method of figuring turbine steam consumption.

51 **Diesel Engines**—Bulletin S-500-B38 illustrates and describes the type DD, totally enclosed, four cycle-direct injection Worthington Diesel engine. Specifications and dimensions are completely described in the bulletin. Worthington convertible engines Diesel type EEX and gas type EEGX are described in Bulletin S-500-B39. Worthington Pump and Machinery Corp.

52 **Wheel Turbine**—Bulletin S-116—8 pages—illustrates and describes application, construction, savings effected and advantages of the Terry wheel turbine. The Terry Steam Turbine Co.

53 **Diesel Power**—Bulletin 138 explains operation, discusses economy and describes savings possible with De La Vergne Model VM, four cycle Diesel engines. Mechanical details of design and construction included. Baldwin De La Vergne Sales Corp.

WATER TREATMENT

54 **Water Conditioning** — Dearborn Chemical Co. has issued an 8-page booklet "Let Dearborn Guard Your Boiler Plant," which outlines the problems involved in conditioning boiler feed water and explains the Dearborn method of analysis and treatment.

55 **Chemical Feeder**—Permutit Co. 4-page illustrated bulletin describes oscillating type dry chemical feeder. Capacities, specifications and line drawings included to show construction.

56 **Corrosion Resistance**—Newly revised Bulletin 1290 describes application of Apexior, a protective coating for boilers, turbines, feed water heaters, condensers, etc. The Dampney Company of America.

57 **Feedwater Treatment**—Bulletin 550 clearly and concisely describes the subject of boiler water treatment. Starting with a treatise on water and its impurities, this bulletin explains the essential steps required in correctly treating boiler water. It also tells about free consulting and laboratory service. Elgin Softener Corp.

58 **Water Analysis**—20-page Water Analysis Manual contains complete facts on water analysis by authorities. Tells how to obtain representative samples and follows through with correct procedure and calculations of results for each test. Chemicals required enumerated, and apparatus illustrated. W. H. & L. D. Betz.

59 **Water Treatment** — "Seventeen Case Studies From The Files of Hall Laboratories" is the title of a recently published book on modern water treatment. It describes the boiler scale and corrosion problems faced by various types of industrial plants, and methods used for overcoming these problems.

MISCELLANEOUS

60 **Information on Packings**—Catalog just off the press gives complete data on all types of packings for every service. Service charts are included to make the proper packing selection an easy matter. The Belmont Packing & Rubber Co.

This card should be filled in completely in order to secure the literature you request. Please indicate only the bulletins you particularly desire.

POWER PLANT ENGINEERING — OCTOBER

Please have the manufacturers send me without obligation the literature indicated by the following paragraph numbers.....

.....

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Name..... Title.....

Company.....

Address.....

61 Unit Heaters — Data book gives complete description of 3 types and 30 sizes of unit heaters for every heating need, and presents underlying principles, advantages and economies of unit heating; listing 14 points of superiority of Thermolier unit heaters. Grinnell Co., Inc.

62 Welded Floats—W. H. Nicholson & Co. 4-page Bulletin 339, covers welded stainless-steel floats, and chromium - plated - steel plates. List prices of elliptical floats given, and prices of other floats presented with descriptions.

63 Packings and Gaskets—Fifty-two page catalog gives description of different types of packings and gaskets for industrial service, and contains data to aid you in choosing the most economical type for your needs. Johns-Manville.

64 Humidifiers—New 8-page bulletin containing helpful engineering information about humidification for industrial plants. Catalog data on the Armstrong line of steam type humidifiers. Published by Armstrong Machine Works.

65 Braided Packing—Descriptive folder tells you all about a packing with an entirely new braided construction claimed to give longer and more satisfactory service. All braided strands are lattice-linked into a structural unit, resulting in greater strength, longer life, semi-automatic action and unusual flexibility. The Garlock Packing Co.

66 Lubrication—Lubricate Div., Fiske Bros. Refining Co. 16-page folder describes "Lubricate" lubricant covering the fluid series, the "100", "200", and "300" series, and applications for general use. Also includes data on plain, ball and roller bearings and gears.

67 Mechanical Packings—A. W. Chesterton Co., 64 India St. 20-page Catalog No. 20 covers only those packings essential to efficient plant maintenance, eliminating hodgepodge of overlapping and duplicating styles. Recommendation chart shows style best suited to various packing problems. Also includes data on tube scrapers.

68 Story of Champion Coal—Beautifully illustrated 28-page booklet bearing that title describes the mining, preparation and distribution of Champion coal. Also, contains interesting data on origin of coal. Pittsburgh Coal Co.

69 Industrial Lubrication—Well illustrated 36-page file folder, "Serving Industry," pictures and describes approved methods of lubricating steam engines, turbines, generators, air compressors, belt conveyors, crushers, steam shovels and other power plant and industrial equipment. Contains blank pages for lubrication memoranda. Published by Sun Oil Company.

70 Building Maintenance Handbook—Just off the press—68 pages of technical information for plant engineers, superintendents and maintenance men. Shows how to do hundreds of odd jobs at lower cost with better results. Presents many ideas that save valuable time and materials. Over 150 pictures, diagrams, mechanical drawings. Non-technically written. Flexrock Company.

71 Lubrication Service — Booklet, "Gulf Periodic Consultation Service," suggests latest practical methods by which lubrication efficiency may be stepped up on turbines, engines, motors and other power equipment. Gulf Oil Corp.

Clean any tube with **LAGONDA LIBERTY CLEANERS**

Look down the line and select the cleaner that your job needs! No matter what tubes or pipes you have—whether straight or curved, large or small—LAGONDA-LIBERTY Tube Cleaners can clean them. Use LAGONDA-LIBERTY'S forty years of design experience. Clean your tubes with fast, powerful machines equipped correctly to do your job of cleaning.

A tube cleaning bulletin, of interest to power plant men, is ready for your request.

Y-154C

ELLIOTT COMPANY

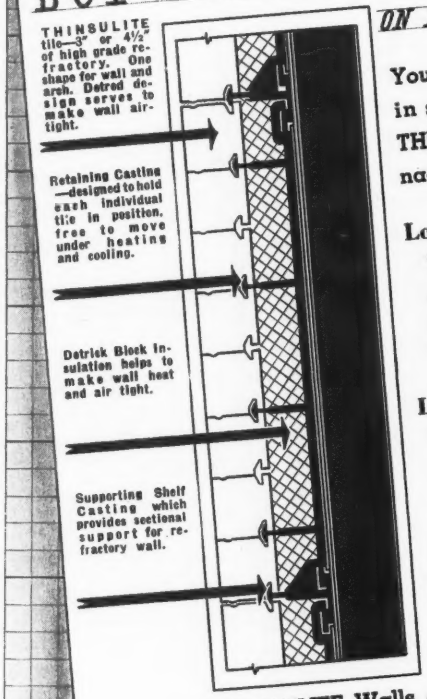
LAGONDA-LIBERTY

Tube Cleaner Dept., **SPRINGFIELD, O.**

District Offices in Principal Cities

BUY FURNACE WALLS

ON A COST PER YEAR BASIS


THINSULITE tile—3" or 4½" of high grade refractory. One shape for wall and arch. Detred design serves to make wall air-tight.
Retaining Casting—designed to hold each individual tile in position, free to move under heating and cooling.
Detrick Block Insulation helps to make wall heat and air tight.
Supporting Shelf Casting which provides sectional support for refractory wall.

Your annual costs can be lowered in several ways by selecting THINSULITE Construction for furnace walls and arches.

Lower initial costs:
The light weight and simple construction results in less material, less time, less labor and lighter foundations.

Longer useful life:
The suspended construction takes up the shock of fluctuating temperatures and remains heat tight and airtight.

More continuous operation:
There are no shut-downs because of refractory failure.

THINSULITE Walls and Arches are applicable to furnaces where erosion and slagging are not severe and temperatures are moderate. Detred Construction is used for heavier service.

Be sure to consult Detrick on your next refractory job. Ask for THINSULITE Catalog showing heat transfer curves and details of construction.

Thinsulite WALLS and ARCHES

M. H. DETRICK COMPANY
140 S. DEARBORN ST. CHICAGO, ILLINOIS

Reliable Buying Bulletins

In these pages you will find advertisements of firms that make every type of machinery and equipment for generating, distributing and utilizing power. Their messages constantly record latest progress in power plant equipment. They tell you who makes it, who stands behind it. Consider their advertisements as convenient and reliable buying bulletins.

(News continued from page 116)

Large Coal Handling Installation for Chicago Plant

ONE OF THE largest coal handling installations ever made by the Robins Conveying Belt Co. of Passaic, N. J., will be made by that company for one of the Commonwealth Edison Company's plants in Chicago.

The equipment in general consists of a Gantry type bridge for unloading and reloading coal barges in conjunction with a storage and reclaiming system. A reversible Conveyor System includes a Traveling Stacker and a Traveling Barge and Car Loading Boom, an auxiliary Traveling Tower Crane with cantilevered Trolley Boom that unloads barges only and transfers coal to the Conveyor System leading to a Breaker House and Main Power Station Coal Bunkers. Two Barge Shifting Units are also included, each of which contemplates the movement of barges along an 850 foot long dock. The initial capacity of this equipment is for 800 T.P.H. of R.O.M. coal.

ELGIN SOFTENER CORP., Elgin, Ill., announces the opening of an office at 215 North Mason Street, Appleton, Wisconsin. The office will be in charge of Mr. Ralph H. Williams who has been handling the Elgin line of water conditioning equipment in Wisconsin. Mr. Williams who is a most competent engineer with over 20 yr. experience, is particularly well qualified to give sound advice on every engineering and chemical phase of water conditioning.

GEORGE B. HARRINGTON, President of the Chicago, Wilmington and Franklin Coal Co., Chicago, has been named chairman of the 18th Annual Coal Convention and Exposition of the American Mining Congress scheduled for Cincinnati, O., April 28 through May 2, 1941. Under his direction, industry committees representing coal producing areas throughout the nation will prepare a convention program which will include discussions of coal mine operation, particularly to advances of mine modernization movement.

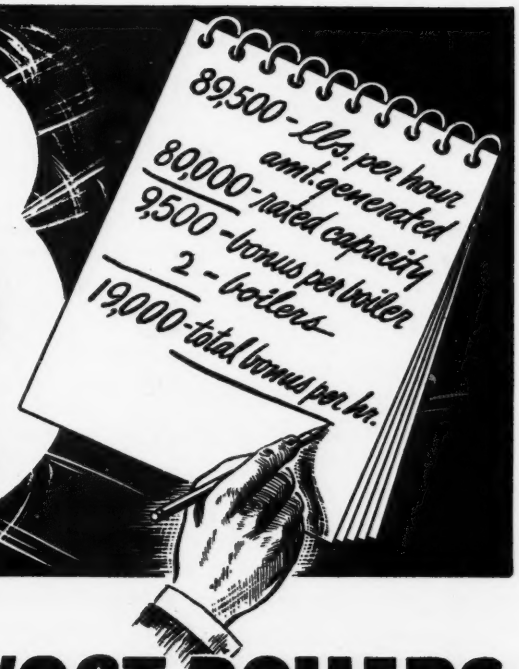
DAVID L. FISKE, executive secretary of The American Society of Refrigerating Engineers, has been appointed to work under the National Resources Planning Board in preparing a national roster of scientific and specialized personnel for use in national emergency. Another member of the committee is Crosby Field, past president of the A. S. R. E., who is active in mechanical and chemical engineering and ordnance work. Four councils represent the Science Committee of the N. R. P. B.—the Social Science Research Council, Council of Learned Societies, American Council on Education and National Research Council.

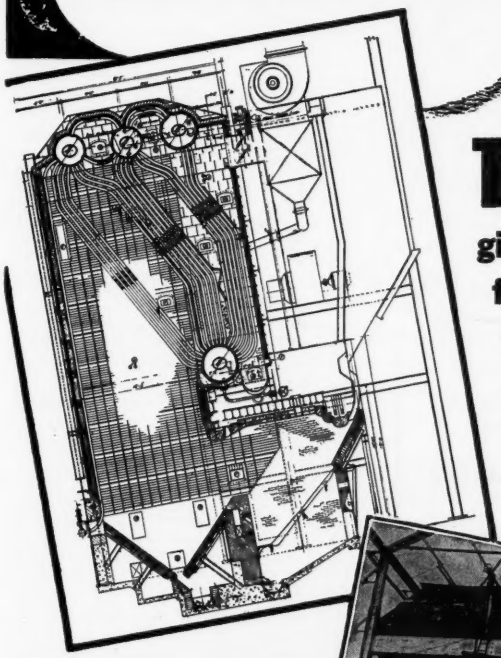
RELIANCE Electric & Engineering Co. is opening a sales office in Houston, Texas, with Frank A. Denison, Jr., as District Manager, it is announced by James W. Corey, Vice President in charge of sales.

Although a native of Texas, Mr. Denison goes to his new responsibilities in Houston from Reliance's Detroit office, where he has been a member of the sales engineering staff since early 1937.

Tinkham Veale, in the sales service department of Reliance in Cleveland, succeeds Mr. Denison in Detroit.

11½% STEAM BONUS





Two VOGT BOILERS

give 19,000 extra lbs. of steam per hour for Newport Industries, Pensacola, Fla.

Generating 89,500 pounds of steam per hour daily from units designed for 80,000 pounds, this large Southern Wood Naval Stores and Chemical Plant gets a *bonus* of 9,500 pounds of steam per hour from each of the two VOGT boilers, shown in the picture below. Wood and gas fuel is burned in combination, and the performance of these units is highly satisfactory to our customer.

Get more for your steam dollars, whether expended for plant or fuel, with plus-value VOGT steam generators. There is a type and size, for any pressure and any fuel, which will exactly meet your operating requirements with lowest operating and maintenance expense.

PRINCIPAL DATA, EACH UNIT

HEATING SURFACE:
Boiler, 12,200 square feet
Water Walls, 520 square feet
CAPACITY:
80,000 pounds steam per hour
OPERATING PRESSURE:
160 pounds per square inch
DESIGN PRESSURE:
450 pounds per square inch
FEED WATER TEMPERATURE:
230 degrees F.
FUEL:
Spent Wood, 7720 B. T. U. as fired (20% moisture)
Natural Gas, 1015 B. T. U. per cubic foot

HENRY VOGT MACHINE CO.
INCORPORATED
LOUISVILLE, KENTUCKY
New York • Philadelphia • Cleveland
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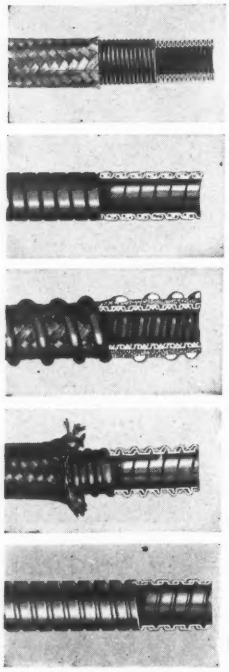
Vogt WATER TUBE BOILERS
BENT TUBE, SECTIONAL HEADER & BOXHEADER TYPES

NEW BULLETINS POINT WAY



To Trouble-free Service with FLEXIBLE Pipe

1 **PENFLEX-WELD is the new corrugated jointless tubing for all services where leaks are fatal. In steel or bronze. See Bulletin 90.**

2 **PENFLEX 4-WALL INTERLOCKED, pioneer of flexible safety, described in Bulletins 52 and 59. Tank Car, Bulletin 55; and Marine, Bulletin 58.**

3 **PENFLEX HIGH RIDGE is a medium duty type offering many possibilities to ingenious designers: Bulletins 52 and 59.**

4 **PENFLEX EXTRA-FLEX has greatest flexibility consistent with safety: Write for Bulletins 52 and 59.**

5 **PENFLEX LIGHTWEIGHT is widely used for conduits, conveying light material, vent ducts, spouts, etc. Bulletin 60.**

PENFLEX

Tight as Pipe . . . but Flexible

Pennsylvania Flexible Metallic Tubing Co.

7207 Powers Lane, Philadelphia, Pa.

It's Snap-on *for* Safety

. . . when you need extra power for "buried" nuts

No matter how "buried" a big nut may be—there's a Snap-on Extra Heavy Duty Loxocket wrench that will reach and turn it . . . SAFELY. Loxocket combinations are as safe as a one-piece wrench—will not come apart accidentally. Positive button release permits quick change of socket set ups.

Snap-on builds a complete line of power plant tools—with service conveniently near you from one or more of 35 warehouses. See Snap-on Tools in your phone directory or send for a catalog.

EXTRA HEAVY DUTY WRENCH SERIES

A complete range of socket wrench sizes 1 7/16" to 3 1/8" plus a complete range of Extra Heavy Duty handle equipment including ratchets, extension bars, sliding bars and adaptors.

SNAP-ON TOOLS CORP.

Dept. PPE-10 Kenosha, Wisconsin

WITH PLANT expansion under way or definitely projected in more than half the nation's metal working establishments alone, manufacturers of power plant equipment and mill supplies are showing a lively interest in the new business prospect, according to Charles F. Roth, president of the International Exposition Company and manager of the 14th National Exposition of Power and Mechanical Engineering. The Power Show will be held in Grand Central Palace, New York, December 2 to 7, coincident with the annual meeting of The American Society of Mechanical Engineers.

D. W. HAERING & Co., 2308 S. Winchester Ave., Chicago, Ill., announce expansion of their Chicago Research Laboratories to permit of additional studies in the fields of scale and corrosion control. Among the more interesting additions is a group of experimental cooling systems designed to duplicate operating conditions while permitting control of variables.

These experimental systems include heat transfer units, redwood towers, circulating pumps and experimental sections for removal and observation. Temperatures, water velocities and wind velocities may be varied at will. Six identical units make it possible to run six operating experiments under the same atmospheric conditions reducing variables to controlled characteristics for experimental studies.

COLONEL W. F. ROCKWELL, President of the Pittsburgh Equitable Meter Company, has announced the election of Mr. A. D. MacLean to the Vice Presidency of the Company. Mr. MacLean is a graduate of the School of Engineering, Harvard University. Immediately upon receiving his degree, he enlisted in the Army Air Service Corps, serving therein until the Armistice in the World War. His first connection in industry was with the Ashton Valve Co. of Cambridge, Mass., as Chief Draftsman. He later accepted a position with the Engineering Department of the New Departure Division of General Motors Corp. and was subsequently promoted to become Assistant Chief Engineer. In 1926 he joined the EMCO organization as Chief Engineer.

R. L. HIBBARD, formerly of the Cutler-Hammer New York office has been appointed to the Merchandising Sales Staff of the Detroit office, according to an announcement by Mr. E. F. Weiss, manager of the Detroit district territory. With a thorough knowledge of C-H Merchandising items which include Safety Switches, Service Control, and Motor Control; and a number of years' experience in the practical application of this equipment Mr. Hibbard brings a valuable background to the many Cutler-Hammer customers in the Detroit area.

THE 4TH Industrial Products Exhibit will be held in Milwaukee. Wis., at the Hotel Schroeder, Oct. 22-23.

ANKER WINTHER has been made assistant general sales manager of the York Ice Machinery Corp., according to an announcement by John R. Hertzler, general sales manager. Mr. Winther is a native of Brooklyn, N. Y., born there in 1905. He went to Stevens Institute of Technology, obtained his B.S. in mechanical engineering in 1928. On leaving college he entered the York student course.

YOUR CABLES

CAN'T DO THIS

BUT YOU CAN DO THIS

INSTALL DELTABESTON

In all probability there are "torrid zones" in your plant where heat is causing rapid deterioration of the insulation on power cables.

Costly electrical breakdowns occur frequently in boiler rooms, foundries, ash pits, cranes, etc —locations where ordinary cable insulations cannot cope with the excessive heat.

You can prevent current failures in those "torrid zones" if you install General Electric Deltabeston Power Cables. The following Deltabeston Power Cables are helping to give many industrial plants uninterrupted service and maintenance savings.

Deltabeston Boiler Room Wire, YK3160

Insulated with felted asbestos, varnished cambric insert, and asbestos braid — maximum copper temperature — 110°C (230°F). For general conduit and boiler room wiring where temperatures are high.

Deltabeston Apparatus or Motor Lead Cable, YK2251

Insulated with felted asbestos, varnished cambric insert, and asbestos braid—maximum copper temperature—110°C (230°F). Great flexibility—recommended for all low-voltage apparatus where operating temperature is high.

Deltabeston Power Cable, YK2250

Insulated with felted asbestos, varnished cambric insert, and asbestos braid—maximum copper temperature—110°C (230°F). For general power wiring where temperatures are high.

Send for a G-E Deltabeston Power Cable Catalog. Section Y-0857, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

GENERAL ELECTRIC

How To Tell If BOILER PERFORMANCE Is Below Par

THROUGH the accurate totalizations of flow of Boiler Feed and Turbine Condensate provided by the new Simplex Gyrometer you can readily detect the causes that are responsible for under-par boiler performance.

The Gyrometer is equally accurate and reliable when used for measuring Steam, Air, Gases and Corrosive Liquors. It is designed for use with orifices, nozzles or venturis. Low in first cost and requires minimum maintenance.

Let us show you how this inexpensive and reliable unit can help you solve your plant metering problems. Write for descriptive bulletin.

SIMPLEX VALVE & METER CO.
6790 Upland St. Philadelphia, Pa.

SIMPLEX
•
GYROMETER

Productivity, Wages and National Income

IN A PAMPHLET under the above title prepared by Spurgeon Bell and published by the Brookings Institute, the author has made an analysis of four major divisions of American industry: manufacturing, mining, railroads and electric light and power utilities. It is stated that taken together these four divisions account for approximately 75 per cent of the industrial wage disbursements in the United States. The analysis covers substantially the last two decades.

Summarizing the manufacturing industry, it is stated that there was a continuous increase in productivity in the manufacturing industries throughout the period under review, but the rate of increase was considerably less rapid in the thirties. The volume of output kept pace with the increase in productivity during the twenties; but in the thirties output failed to expand at all. Owing to the increase in output in the twenties, employment both in terms of numbers of wage earners and of man-hours was maintained—even showing a slight increase. But the restriction of output in the thirties meant a great decline in man-hours of employment, though not in the number of wage earners. Hourly earnings of labor increased throughout the period, but because of the decrease in man-hours of employment weekly earnings declined materially. Thanks to the reduction in the cost of living, however, the purchasing power of employed labor showed a moderate increase.

Minerals

The substitution of machinery for hand labor in the mining industry proceeded at an exceptionally rapid pace during the past two decades, amounting virtually to a technological revolution. In the prosperity period of the twenties the output per man-hour increased as much as 32 per cent. In the years following 1929 the average rate of increase was almost as rapid, amounting to 43 per cent—making an 89 per cent increase in the entire period. The physical volume of production in mining did not keep pace with the increase in productivity during either the twenties or the thirties. In the former period the output increased only half as much as productivity, while in the later period the output actually declined. As a result of the restriction of output, employment declined throughout the entire period. Hourly earnings declined considerably in the twenties—in sharp contrast to the trend in manufacturing and in railroads. In the thirties, however, hourly earnings rose sharply, with the result that the net increase over the period as a whole was 1.7 per cent. It should be stated here that hourly earnings in the mining industry have been at a higher level than in the manufacturing and railway industries. Weekly earnings declined throughout the period, the decrease amounting to as much as 30 per cent. Real weekly wages moved closely with money wages in the twenties; but, thanks to the reduction in the cost of living, the decline in weekly earnings during the period as a whole was only 19 per

(Continued on Page 128)

Cut MAINTENANCE *Cost*

Use this 500 Brinnell, Full Plug Valve on auxiliary steam lines. Suited to severe throttling conditions

In this new 531-P Union Bonnet Bronze Globe Valve you will find character that promises exceptionally long service free from maintenance—even when operated at its maximum of temperature and pressure—even when used for severe throttling service at high pressure.

The qualities you want in valves for your auxiliary steam lines have been engineered into this valve for you.

Details of the 531-P: Body of special hard bronze that is stable when under continuous maximum pressure and temperature. Bevel joint between body and bonnet. Stems of high strength, rolled bronze provide excellent resistance to corrosion. Full plug stainless steel seats and discs heat treated to have 500 Brinnell hardness and to prevent galling. Precision machined to have full bearing. Ample stuffing boxes. Bronze follower and packing nut.

Get our recommendations for using the 531-P in your service and write us whenever you want information on valves. You will find our suggestions to be sound—based on close contact with many of the problems of your business.

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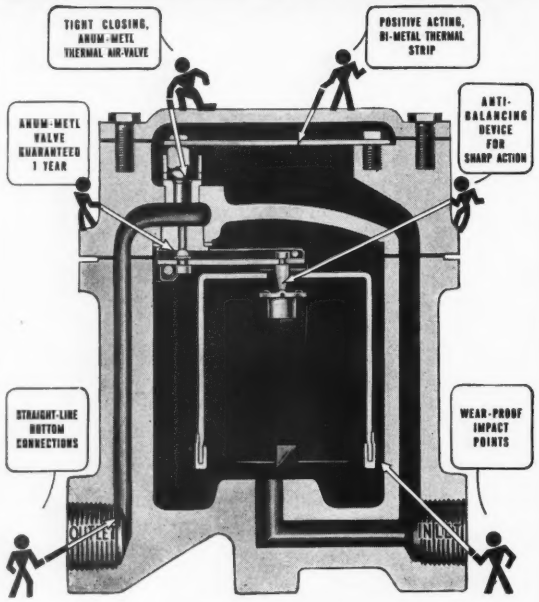
DIVISION · · READING, PENNSYLVANIA

AMERICAN CHAIN & CABLE COMPANY, Inc.

PIPEWRENCH PETE SAYS:

HERE'S THE SURE WAY TO GET HEAT FAST AND CHEAP



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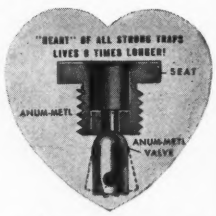
EVERY FEATURE A MONEYSAVER!

Unit heaters and cookers can be lazy or quick . . . tepid or torrid . . . costly or cheap. They're efficient only when you remove air and water quickly, so steam can fill them.

That makes the trap important. Makes the 6 moneysaving features of STRONG'S 70-T quick-starting trap vital if you're going to get heat FAST and CHEAP! Same sturdy construction as STRONG'S 80 series trap. A year's guarantee against leakage, too. Worth a 90-day money-back test? Your inquiry will get action quick!



ALL STRONG traps and valves have seats and discs of special ANUM-METL that lasts 8 times longer than even STRONG'S former parts. A big money saver!

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The Strong, Carlisle & Hammond Co.
1392 West Third St., Cleveland, O.

STRONG
STEAM SPECIALTIES

cent, as compared with a 30 per cent decrease in weekly money wages.

Railroads

In appraising the significance of the changes which have occurred in productivity, output, employment, and wages in the railroad industry, it is important to bear in mind that railway mileage was declining throughout the entire period. With the railway net of the country fully developed, the primary task of the railroads was to improve the quality of plant and equipment. A strong impetus to such improvements was given by two developments. The first was the high wage level resulting from the increases made during the World War period of government control. The second was the rapid development in the postwar period of competing forms of transportation.

Electric Light and Power

The electric light and power industry presents a striking contrast with the railroads in that it has undergone a rapid growth during the period under review. The rate of development, moreover, has been very much more rapid than has been the case in mining and manufacturing. In consequence, the relations between man-hour productivity, output, employment, and wages present significant variations.

During the whole period under review, output per man-hour increased by well over 100 per cent. It is interesting to note that in this industry the rate of increase in productivity was more rapid in the thirties than it was in the expansion period of the twenties. The explanation is to be found in the fact that in the twenties there was a rapid expansion in the number of establishments, whereas in the thirties primary emphasis was being placed upon the improvement in the productive efficiency of existing establishments.

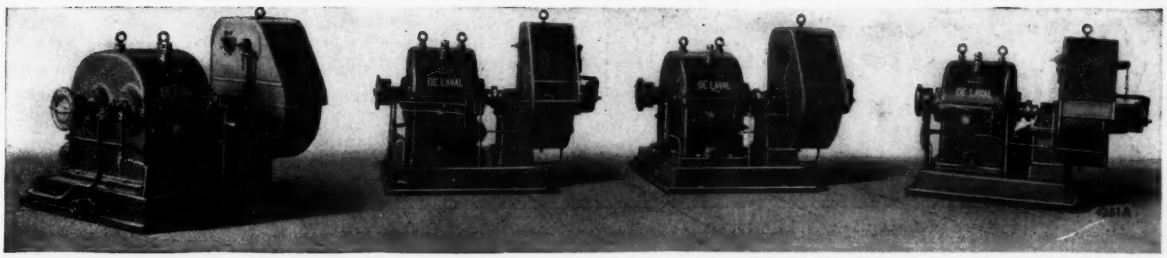
The aggregate volume of output in the twenties increased more rapidly than productivity—a result of the general expansion which was occurring in the industry. In the thirties the volume of production also increased greatly—41 per cent—though not so much as did productivity. This is in striking contrast to the situation in the three other industries covered, all of which show an actual decrease in output between 1928-29 and 1936-37. The period as a whole shows an increase in output substantially in excess of the increase in man-hour productivity.

This industry is also a striking case when looked at from the angle of employment. During the prosperity period of the twenties the increasing productivity per man-hour was not accompanied by any decrease in employment. On the contrary, in this expanding industry, the number of wage earners increased 41 per cent in the five-year period, and the number of man-hours increased 31 per cent—in exact proportion to the increase in productivity.

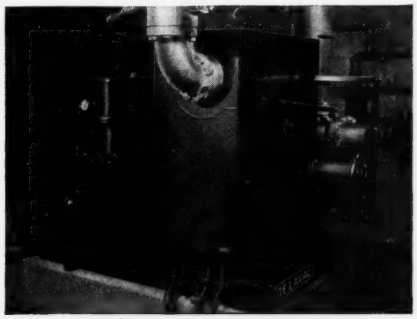
In the thirties, however, a 61 per cent increase in productivity was accompanied by a substantial decrease in employment—not withstanding a 41 per cent increase in the volume of production. Thanks to the concentrated efforts to increase man-hour output during this period, a large increase in output became possible with a reduced number of workers.

Hourly earnings increased throughout the period,

(Continued on Page 130)

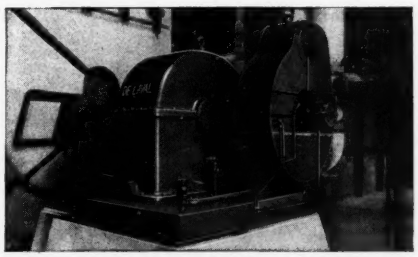


● Four velocity-stage geared turbines for induced fan drive; to use superheated steam at 475 psi.



● Velocity-stage geared turbine driving forced draft fan in paper mill.

● Velocity-stage geared turbine driving induced draft fan.



● Velocity-stage geared turbine driving forced draft fan in steel mill; using steam at 450 psi. and 750° F.; 125 hp. at 3440 r. p. m. turbine speed and 1450 r. p. m. fan speed.

Draft Fan Drives

Steam plant auxiliaries require variable speeds, particularly fan drives.

DE LAVAL GEARED TURBINES

meet such requirements in an ideal way. Speed reduction permits both turbine and driven machine to run at the speeds respectively most conducive to efficiency.

The speed of the turbine can be adjusted, either manually or automatically, by continuous variation through a wide range, resulting in a great saving of power as compared with throttling the air flow, and also giving better control.

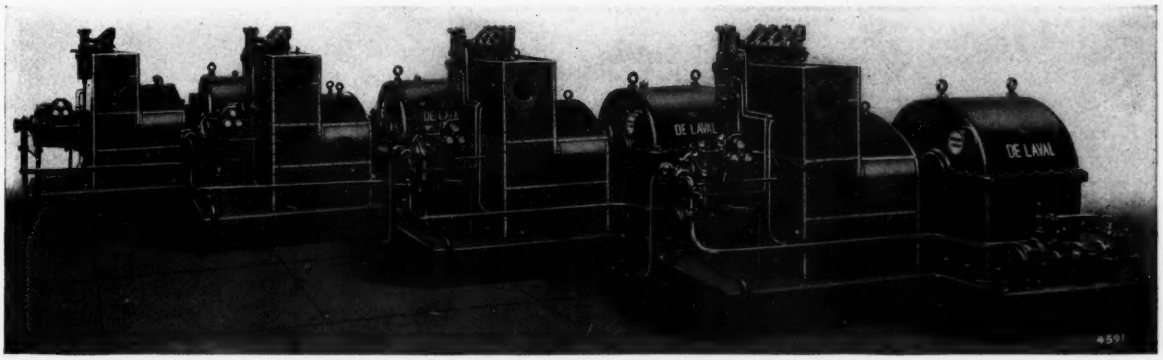
The large powers now required by draft fans, often exceeding 1000 hp., enable turbine drive to compete in economy with motor drive, if the latter is charged with its proper share of electrical losses and equipment costs.

Finally, turbine drive, besides being more flexible and in many cases less expensive than electrical drive, is VASTLY MORE RELIABLE, since it is independent of main units and electrical circuits, and so long as there is steam pressure, is always ready to run.

Write for Publication T-3519

DE LAVAL STEAM TURBINE CO., TRENTON, N.J.

● Four multistage geared turbines to drive induced draft fans; 1200 hp. each at 4750 r. p. m. turbine speed and 1080 r. p. m. fan speed.



MORE BOILER SAFETY AND ECONOMY FOR YOU

Technical School Engineers Point Way by Installing Reliance EYE-HYE Remote Reading Water Gage

THE MOST important development in recent years toward making water level reading a frequent, almost automatic check to insure safe operation of your boilers is the EYE-HYE. It brings a clear, accurate reading down to the operating floor—*down to eye level*—conveniently placed for constant observation.

Since its introduction, EYE-HYE has gained recognition steadily by power users everywhere, by consulting engineers, and by the engineers of many schools and colleges where the safe and efficient operation of equipment is demonstrated often to students.

EYE-HYE'S green indicating fluid is brilliantly illuminated, making the reading visible from a greater distance and quicker than most instruments. Its simple operation, based on the well-known U-tube principle, and rugged construction assure constant error-proof water level check without troublesome adjustments and expensive repairs.

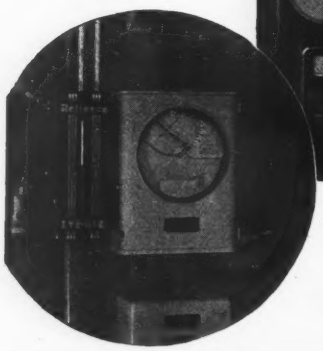
Installation is easy. Two small tubes run up the wall, around pipes and girders, connect EYE-HYE to the boiler drum—no costly piping to do.

The hundreds of engineers who have installed EYE-HYE enjoy new freedom from water level worries—are proud of this modern device among their controls. Add this efficient water level SIGHT check to your boiler room for safety and economy. Write today for Bulletin 382.

The Reliance Gauge Column Company
5902 Carnegie Ave. • Cleveland, Ohio

Some of the Schools and Colleges where EYE-HYE Guards Water Levels

Purdue University
Michigan State College
Case School of Applied Science
Virginia Polytechnic Institute
West Point Military Academy
Louisiana Polytechnic Institute
University of Washington



Above—EYE-HYE takes prominent position on panel at Virginia Polytechnic Institute.

Left—Model E-10 EYE-HYE at Case School of Applied Science, Cleveland.

Reliance
Boiler Safety Devices since 1884

but much more rapidly in the later years when productivity was rising most rapidly. Over the period as a whole there was a 30 per cent rise in hourly wages. Weekly earnings declined slightly in the twenties—owing to the shortening of the working hours. In the thirties weekly earnings show an increase of 10 per cent as compared with 21 per cent in hourly earnings—evidence a further decrease in the number of hours worked per week. The purchasing power of workers in this industry, as measured by real weekly earnings, was practically stationary in the twenties but increased by well over 25 per cent during the thirties.

Regarding the division of the gains to labor, capital and consumers the author summarized his findings with the statement that it is apparent that the consuming public derived the principal benefit from the increase in productivity. The gain to capital was negative in character: had it not been for the increase in productivity the decrease in the rate of return to capital would doubtless have been greater than it was. The money earnings of employed labor declined slightly: such gains as labor received were in the form of leisure. However, both labor and contributors of capital shared in consumer benefits.

The interesting conclusion the author derived from his analysis is that the distribution of savings from increasing productivity to consumers in the form of lower prices may be more desirable than their distribution directly either to employed labor or to capital. Since wage and salary workers and those who contribute capital constitute the great bulk of the consuming population, most of the gains from price reductions automatically accrue to them. Labor also benefits from the maintenance of employment. Aggregate production and aggregate employment are maintained and expanded, and the long-run interests of the laboring population are best served.

Production Costs Rising

PRODUCTION costs are expected to rise as a result of the speeding up of preparation for national defense, in the opinion of leading industrialists who were polled on this matter by the Division of Industrial Economics of The Conference Board.

With some three hundred executives participating in the poll, approximately three-fourths of the industrialists expressed their conviction that a sharp rise in general production costs will be unavoidable and that the relatively small cost increases in the past year are unreliable indicators of what may be expected in the near future.

"As the rearmament program moves forward," The Conference Board reports, "it is expected to be accompanied by higher wage rates, particularly for skilled labor, increased material costs and, of course, a rising tax burden." Fear that increased production may not bring about unit savings is expressed in some of the replies, as recent experience shows that new orders have resulted in greater overtime charges and increased competition for skilled workers.

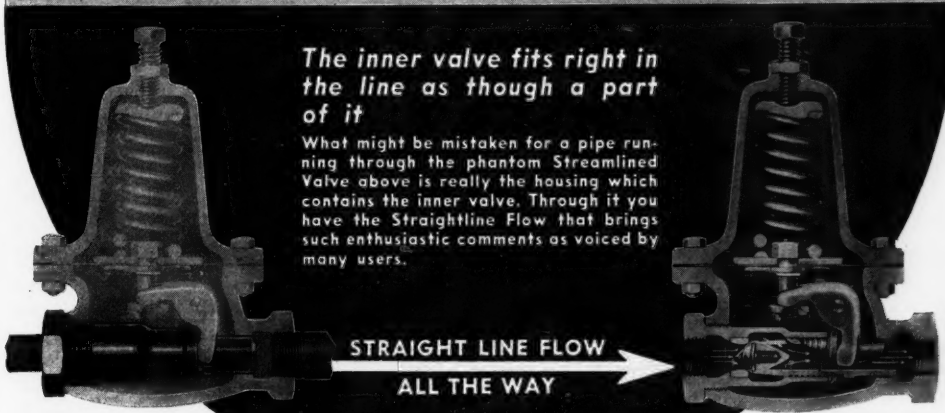
That moderate advances in production costs have

(Continued on Page 132)

"Speeded Up OPERATIONS ABOUT 20 TO 25%"

Note—SIMILAR RESULTS BEING EXPERIENCED BY WIDE VARIETY OF USERS

"We are glad to tell you that your Streamlined 1000-LP Valve has enabled us to speed up operation on our Hosiery Setting Machine about 20 to 25%. This is because your Valve gives such rapid action in bringing up the pressure and in holding the pressure constant during the preboarding operation."



The inner valve fits right in the line as though a part of it

What might be mistaken for a pipe running through the phantom Streamlined Valve above is really the housing which contains the inner valve. Through it you have the Straightline Flow that brings such enthusiastic comments as voiced by many users.

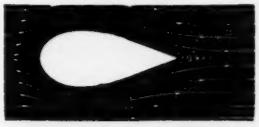
CASH STANDARD *Streamlined* TYPE 1000 PRESSURE REDUCING VALVE

A valuable tool to help you speed operations, cut maintenance, save money

VALVE TURBULENCE ELIMINATED

The valve increases performance results by eliminating the ordinary valve turbulence indicated in illustration above. There is no detour around a dividing wall — the direction of flow is not changed at right angles because of a seat wall—also, the flow is not broken up by valve stems, springs, or other parts.

REDUCED PRESSURE NEVER VARIES



You get Streamlined flow as indicated in illustration above. Because of this Streamlined flow and no turbulence, you are easily able to meet peak demand and yet hold the reduced pressure constant at the same time. You experience no spoilage results due to erratic pressure — because the reduced pressure never varies.

***Free* TRIAL** **Prove for yourself what others say about CASH STANDARD Streamlined Valves—do it at no cost—tell us to ship one to you on 30 days' free trial—after 30 days you get a bill—you either pay for it then or return valve to us at our expense—order one on trial today—see why there are no failures—decreased attention costs—no heat or chemical troubles.**

BULLETIN 1000 TELLS COMPLETE STORY

You may select a CASH STANDARD Streamlined Valve exactly suited for your service conditions. Bulletin 1000 shows how. Any combination of metals can be obtained for body, trim, valve seat, and seat ring. Handwheels for quick pressure adjustment also available.

IMPORTANT CHARTS SHOWN IN BULLETIN 1000

Steam, air, water capacity charts for all Streamlined Type 1000 Valves are shown in Bulletin 1000. These charts are easy to use—they enable you to determine precisely how much fluid any size Streamlined Valve will deliver under your exact pressure conditions—for steam, air (and other gases), water (and other liquids).

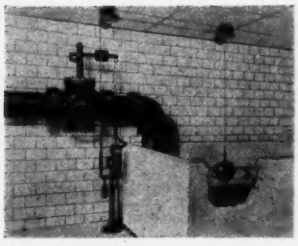
CASH STANDARD CONTROLS . . VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

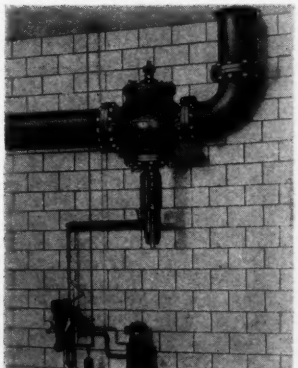
A CASH STANDARD "GET ACQUAINTED" COLUMN

Question: **"Don't you people make anything besides that Streamlined Valve you talk about so much?"**

Answer: **"Yes Sir; we do! And we propose to picture one or two of them here each time."**



In automatic liquid level control, two things are often of prime importance: (1) to hold the level within the closest kind of limits; (2) to do it dependably, day by day. How Cash Standard controls do both is shown above. A Type 100-L Controller operates a 12" Balanced Valve regulating liquid supply to a large tank. It is pilot actuated for sensitivity. It has operating power to spare —for any size Valve, however large.



Here, a Type 100-L Controller operates a 10" Cash Standard Balanced Valve. It regulates flow through a make-up line to a "dirty water" heater on the floor above. The lever of the "100-L" responds to slightest movement of a float in the heater—causing immediate movement of the power piston which operates the Valve. But there is no "hunting" because the Controller is fully compensated. It has a "range" adjustment too. It gets accurate results with any size valve—no matter how small or how large the valve may be. It is simply a matter of using the right size power cylinder.

Get Free Bulletins on Above . . . Write to A. W. CASH COMPANY DECATUR, ILL.

JUST A FEW MINUTES NOW AND YOU'LL BE AS GOOD AS NEW

About 99% of valve wear comes on the seat rings or discs. When they're worn, the rest of the valve is usually as good as new.

Then doesn't it strike you as absurd and wasteful to throw away an *entire* valve merely because a small, inexpensive part is worn out?

Fairbanks RENEWABLE Valves eliminate this big waste. If a leak develops, you simply remove the worn seat ring or disc and slip in a new one. The whole operation takes only a jiffy. You don't even have to remove the valve from the pipe line or disturb the covering.

And the cost is only *cents* compared with *dollars* for a whole new valve. In addition, this saves the time, trouble and expense of removing non-renewable types from the pipe line and does away with costly shut-downs.

Why not stop this deplorable waste now by replacing your worn valves with Fairbanks "Renewables"!

Write for catalog No. 21 and name of our nearest distributor.

Fig. 0302
150 lbs. steam pressure

THE FAIRBANKS CO.

399 Lafayette St., New York, N. Y.
Valves, Dart Unions, Hand Trucks and Wheelbarrows
Boston, Pittsburgh—Distributors in Principal Cities
Factories: Binghamton, N. Y., Rome, Ga.

Fairbanks Renewable Valves

already occurred is revealed in the replies of less than half of the industrialists. They state that the increases have been caused in large part by rising cost of materials.

Not all new business derived from the defense program can be viewed as "gravy" is indicated in some of the replies. "The added volume of production resulting from defense procurement," states one, "is not likely to produce normal volume economies to offset such increases in costs for the reason that much of this procurement production must be handled in haste and on an emergency basis to meet emergency delivery dates. For a time at least, this production is likely to be relatively high-cost because of overtime involved, excessive supervisory costs, and the inefficiency inherent in all emergency scheduling." The overtime problem is expected to become greater after October 24, the date on which changes in hours under the "Wage-Hour" act become effective.

Scientists in Industry

IN EXPLAINING why the oil-producing industry in America has been so successful and why, despite the admitted scientific knowledge of some foreign countries, it has taken American oil men to find and produce oil in those countries, a petroleum geologist recently gave his opinion that only in America have scientists been able to get their hands dirty at menial tasks in the oil fields and can roughnecks on the derrick floor talk intelligently about the significance of coring samples and geological structure.

It is no mere coincidence, he holds, that most of the oil fields of the world have been found by American oil men. Only in a society where the educated professional scientist labors freely with his hands, unembarrassed, at menial jobs, can a coöperative effort attain full success. In Russia, geologists comprise one category, drillers another, production engineers another. Each group rigidly is insulated from the others and ultimate control is despotic, centralized, and remote.

Within Russia, according to statements from the American Petroleum Institute, lies much of the most promising oil land in the world, it is believed, yet for more than 20 yr. the country has devoted intense effort to finding and producing more oil. Today America produces six times as much as Russia, which starves for oil while America sells it to the world. Throughout the rest of the world, virtually every important oil field has been found and developed by American oil men. Recently they climaxed a long series of successes in foreign lands by discovering the first commercial oil field in Hungary, and by finding oil in England where it has been sought for decades.

Early participation of geologists in the work of solving the problems of the oil-producing industry constituted a pioneer venture of science into American industry. It demonstrated the outstanding results attainable by effective coöperation between science and industry with the widespread dissemination of the basic facts of the science in question, and of the scientific point of view, throughout the rank and file of the personnel of the entire industry.

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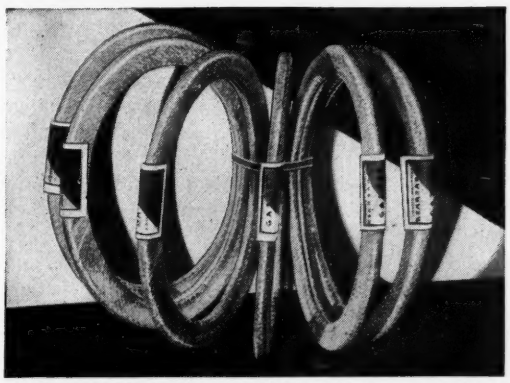
KEEPING 'EM ROLLING — By WESTCOTT



J-M KEARSARGE BOILER GASKETS: This better gasket presents an unbroken, rounded shoulder on the side exposed to pressure . . . gives a permanently tight seal. For boiler handholes, manholes and tube plates.

JOHNS-MANVILLE JM PRODUCTS

P. S. THEY DID! . . . *with tougher, tighter-sealing J-M Kearsarge Boiler Gaskets*

FREQUENT tie-ups for packing or gasket replacements mean more than just a few dollars spent for materials. That condition costs plenty in idle equipment, time and labor charges. Yet much of this expense can be saved by using materials specially built to stand up longer in tough service. The next time you have a replacement job, try J-M Packings and Gaskets and you'll find out what real packing economy means. For more than 60 years, these J-M materials have been establishing outstanding records for dependable, economical service. For details on the complete J-M line, write for the J-M Packing Catalog. Johns-Manville, 22 East 40th Street, New York, N. Y.

JOHNS-MANVILLE PACKINGS & GASKETS

THERE'S A DISTRIBUTOR NEAR YOU

To prevent or stop pipe joint leaks

On Screwed or Flanged Joints

When leaks occur at screw-thread pipe joints, reassembly with Smooth-On No. 3 will assure a lasting seal *even if the threads are worn or damaged.*

On gasketed and other pipe connections, too, Smooth-On makes and keeps the joints tight, because this soft metal filler retains its body, does not dry, shrink or blow out, is not affected by steam, water, oil or gas, and holds perfectly even at high pressures or wide temperature variations.

By making up all new pipe joints with Smooth-On No. 3 and keeping a can handy for use on troublesome old pipe joints, you can be sure of perfect and permanent joint tightness.

Buy Smooth-On No. 3 in 1-lb., 5-lb. cans or 25-lb. kegs from your supply house or if necessary, from us. For your protection, insist on Smooth-On — used by engineers since 1895.

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The 40-page Smooth-On Handbook—full of valuable suggestions that will save you time, effort and money on equipment repairs, such as sealing cracks in heaters, pumps, tanks, etc., stopping leaks at seams and bolts, tightening loose fixtures and parts of apparatus, waterproofing walls, floors, etc. Send the coupon for your copy.

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***Do it with* SMOOTH-ON**

After the first splurge when geologic departments were established in the industry and the universities were scoured for personnel, the supply of graduates in petroleum geology began to exceed the demand. Many of them got jobs as roughnecks, as roustabouts, advancing to drillers and foremen, to scouts and lease men. Gradually geology, which previously had been merely a narrow path to a specialist's job in oil finding, widened into a broad avenue of approach to the whole enterprise of producing oil. Now, many of the most responsible executive positions in the industry are held by geologists, and the scientific viewpoint pervades the whole industry.

This same trend is taking place in the power field where college graduates these days are starting in the most menial positions in power plant organizations.

Bituminous Coal Industry

ON THE first day of October the coal industry goes into a revolutionary phase of its activities—price control at the mines by government edict. To put this legislation into operation has required several years of time to investigate the entire economic conditions surrounding the industry from the various mines to the ultimate consumer. The ultimate purpose is to stabilize the industry, give miners regular employment, insure operators reasonable profits and consumers a fair price. Without question the workings of this legislation will be watched with extreme interest, for the coal industry is one of the most important in this country and its product the essential of nearly all the other great industries including the generation of power.

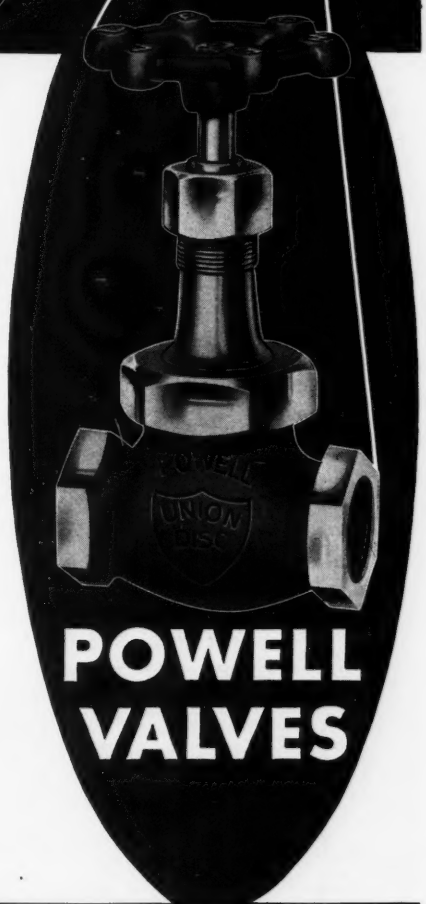
As this fundamental change in the marketing phase of the coal industry goes into effect, the present status of the industry, as outlined a short time ago by T. A. Day of Appalachian Coals, Inc., is an interesting compilation of data well worth consideration at this time, since without doubt many changes in the industry's activities are about to take place. The following paragraphs are abstracted from an address before the Rotary Club of Knoxville, Tenn.

In 1937, according to the Bureau of Mines of the United States Department of the Interior, Kentucky produced over 47 million tons of coal; Tennessee, more than 5 million, coal being the most important mineral resource of the state; Virginia, nearly 14 million; and West Virginia, over 118 million tons. Production of these four states that year amounted to more than 40 per cent of the total mined in the United States.

Mining the tremendous tonnage just referred to provided work for 55,596 employees in Kentucky; 8,465 in Tennessee; 16,494 in Virginia; and for 113,643 men in West Virginia. Coal actually tops the list insofar as employment of labor is concerned, with the exception of wage earners employed by the railroads. In the United States today there are more coal

(Continued on Page 136)

There's more to POWELL QUALITY than meets the BUYER'S EYE!



CALL THEM "CRYSTAL GAZERS", IF YOU LIKE . . . but the kind of future they "see" for POWELL VALVES is based on accurate, scientific analysis!

• The Spectograph is in no sense a fortune teller's "crystal", but in the hands of trained metallurgists, like the Powell technicians shown above, it plays a key role in assuring long life and trouble-free service for all Powell products. It alone can detect minute quantities of detrimental impurities in the metals to be employed which even chemical analyses can't always reveal and which, after years of service, often cause failure, or needless maintenance expense, for the ultimate buyer.

Looking at a valve, fresh from its wrappings, it is natural that you would expect considerable research and laboratory experimentation had accompanied its manufacture. The degree, however, to which such care is taken to assure maximum inherent quality is, in our opinion, a factor far too important to leave to the buyer's imagination.

We give you, therefore, this picture of the Spectograph so that you can have further concrete evidence of the underlying quality we are thinking of when we say, "Powell valves are quality . . . *through and through*"!

THE WM. POWELL CO.
•
CINCINNATI, OHIO

You Need More Than a Photograph of the Finished Product to See ALL of the Qualities that Make Powell Valves Uniquely Able to Better Serve the Power Engineer

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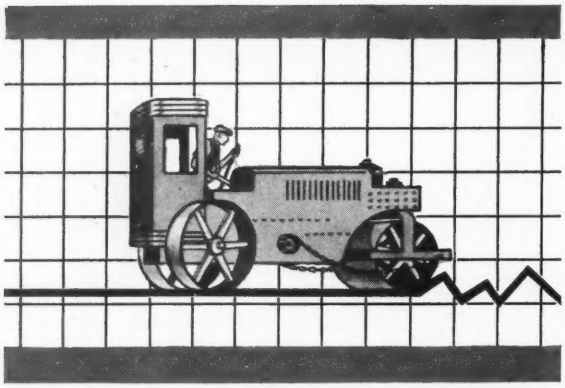


ROLL OUT YOUR VOLTAGE BUMPS

with G-E DIACTOR Regulators

FOR more than five years—on thousands of machines—the quick-action, wide-range rheostatic element of G-E Diactor generator regulators has been giving voltage regulation that is really *smooth.* It provides an almost infinite number of smooth resistance steps from practically zero to the maximum, resulting in a regulation curve that is correspondingly smooth.

Here's how the Diactor regulator helps you to maintain constant voltage. It holds the voltage close to the desired value without hunting or instability. After a change in operating conditions, it quickly returns the voltage to normal. Because of its simple, reliable design, you are not troubled with bothersome, costly maintenance.

Whether your voltage-regulation problem involves a new installation, replacement of old regulating equipment, or providing adequate regulation for machines already in service, you will find a Diactor regulator fitted to your needs.

A specialist in the nearest G-E office can give you detailed information. Or write for bulletin GEA-2022. General Electric Co., Schenectady, N. Y.

GENERAL ELECTRIC

miners than steel workers, more coal miners than auto workers, more men engaged in the production of coal than in the cotton mills or in the shoe factories. Measured by the number of wage earners, the railroads are the largest single employer of labor by a wide margin. The railroad total, according to the latest I.C.C. reports, was 975,625. Coal mining ranks second: bituminous, 462,403; anthracite, 103,269; the total number of wage earners, according to the Bureau of Mines, being 565,672.

Each ton of bituminous coal mined brings $1.27 to the miner in the form of wages. That is the average per ton labor cost at the present time, and a fact we should keep in mind as we look out our back door toward the vast resources of coal in Kentucky, Tennessee, Virginia and West Virginia. As we look back we might also make a comparison between the labor value in coal and that same value in fuel oil, natural gas or water power. For example, the displacement of coal by fuel oil and natural gas, in which the labor content as compared with coal is very small, and the generation of electricity by water power, in which the labor element is infinitesimal, is an angle of the unemployment problem to which the public seemingly has been blind.

The fact is that labor cost in the production of four barrels of fuel oil, the equivalent of one ton of coal, is 68 cents.

The labor cost in the production of 20,000 cu. ft. of natural gas, the fuel equivalent to a ton of coal, is only 8 cents.

The labor cost in 2,000 kw-hr. of hydroelectric power (energy equivalent to a ton of coal) is less than one cent.

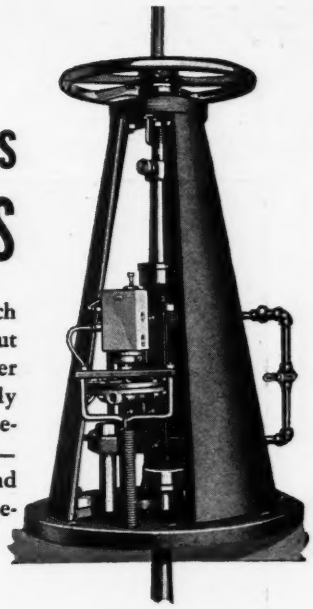
These figures require no comment. They point their own moral, and the moral is that displacement of coal by substitute fuels is one of the major factors in the country's present unemployment problem, a solution of which is so desperately needed.

We are vitally interested in the bituminous coal industry in this section of the South, or should be, and interested also in the railroads and railroad employees which serve the coal industry for we make up one of the many communities which depend upon the prosperity of both the coal mining and transportation industries. We should recognize that bituminous coal is important because it is a dependable source of power, because it employs a large number of men, because it has a large payroll in relation to the value of its product and because the transporting of coal is, in itself, an industry providing employment for many men. It is reported that the producing companies of the Southern high volatile field spend $180,000,000 annually in connection with their opertions.

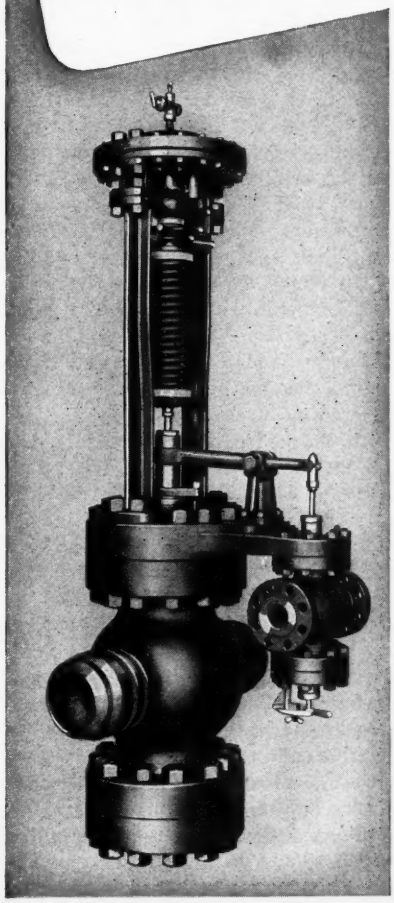
The bituminous coal industry has for some time been engaged in very active efforts directed towards promoting the increased use of coal. A realistic approach to the subject through the media of advertising and research in both coal and coal-burning devices has resulted in at least a sympathetic and better understanding on the part of many users of coal during the past year.

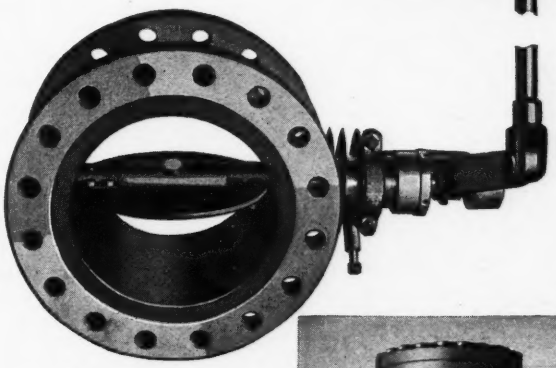
(Continued on Page 140)

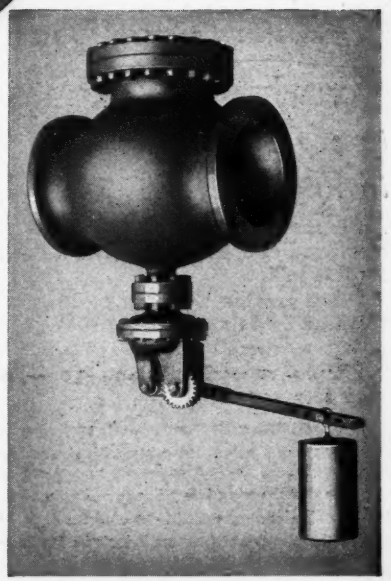
Solve Unusual Pressure Control Problems with SWARTWOUT SPECIAL CONTROLS



IF you've ever had, or are likely to have a pressure control job for which there is no standard valve or control, it pays you to know that Swartwout supplies safe positive-action equipment to fit your needs with least bother and expense • Special Valves, such as a few shown here, are carefully engineered to meet the need. Standard basic parts and mechanisms, with special features where required, are combined to achieve unfailing efficiency—at a reasonable cost. Thirty-six years experience in applying Swartwout and "S-C" valve principles in thousands of installations, guarantees you completely satisfactory performance. . . . Tell us your problem, now.







ABOVE. 12" Butterfly Valve with operating cylinder and manual control stand. The operating cylinder is equipped with a "positioner" which assures identical positions of the butterfly valve for each operating condition. Butterfly Valve built to withstand high pressure and high temperature operating conditions. Weirton Steel Company.

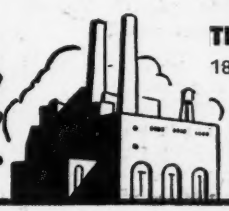
LEFT. A 6" 1500 lb. Std. Pressure Reducing Valve with auxiliary water admission valve controlling supply of water to desuperheater. When the reducing valve cuts in, water supply is also automatically cut in, in accordance with the flow. Columbus & Southern Ohio Electric Company.

RIGHT. A 16", self contained Control Valve operating at pressures from vacuum to 37 lb. The valve is wide open until pressure on the discharge side reaches 37 lb., at which point it accurately maintains this pressure. Union Electric Light & Power Company.

Feed Water Regulators • Pump Governors • Feed Water Heaters
Master Controls • Reducing Valves • Separators • Exhaust Heads

Swartwout

•Power Plant Equipment•



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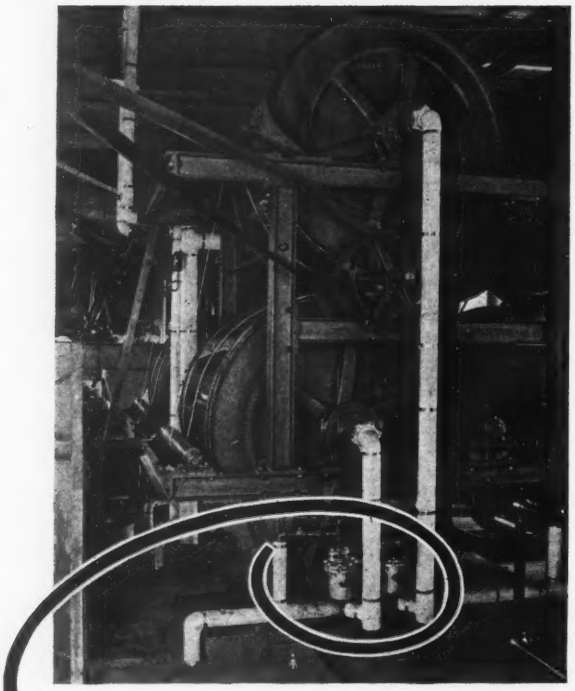
* * *

Controlled **AIR CIRCULATION**
for Power Plants and Industrial Buildings

K-MASTER



2 of Many K-MASTER Inverted Bucket Steam Traps

in a prominent textile finishing mill in Rhode Island . . .

As a matter of fact, this company has so highly approved of the K-Master that it has made it standard for this mill.

What are the K-Master features? What is it about this trap that turns at least 90% of all trial orders into orders for more?

Simple, rugged, efficient—yes—but more definitely such features as:

1—reversible valve and seat, thus giving double life.
2—external valve assembly with no gaskets, pins or threads, reducing time of inspection and valve reversing.
3—self-tightening joints in valve assembly.
4—self-cleaning vent (if desired) for dirty lines.
5—thermo float (if desired) for venting large quantities of air or gas.

Why not try out a K-Master in your plant? You're interested, we take it, in reducing your costs.

Thousands of K-Masters are doing excellent work in hundreds of plants.

KAYE & MACDONALD, Inc.

92 Franklin Avenue West Orange, N. J.

The bituminous coal industry, through its national organization and individual members, has fostered and promoted the use of automatic coal stokers and other coal-burning devices in order to save and promote coal markets. During the first nine months of 1939, reports of the United States Department of Commerce show that total sales of stokers amounted to 71,661, an increase of 5797 machines over the same period of 1938. During the month of September, 20,398 stokers were sold, this being the second time in the history of the industry that a single month's sales passed the 20,000 mark. Of the 71,661 stokers sold from January through September, 1939, 54,526 were of domestic or household size. (This record has been substantially improved in 1940.) Efforts are being made by the producers of coal throughout the nation to perfect stokers and promote their use. The manufacturers of coal pulverizers, which are used largely by industrial plants, as well as many others which manufacture coal-burning devices, including furnaces, stoves, ranges, hot water heaters, etc., are receiving the complete cooperation of coal producers through research and investigation.

Time, effort and money are being spent in both pure and commercial research activities. The possibilities of finding more uses for coal have received a great deal of time and attention.

Improved preparation of coal and modern methods of mining have made better coal and increased its efficiency to a great extent. Through many decades, the industry has progressed from the ancient hand tools, sledge, wedge, pick, shovel and barrows to the use of explosives, to mine cars drawn on tracks by animals and, with the perfection of transmission of compressed air and electricity, to locomotives and mining machines. The only hand tool that has survived to any large extent is the shovel, and it is gradually being replaced by loading machinery.

In keeping with its modernization program, the bituminous coal industry has developed "effort saving" devices through the years. No single development has created revolutionary changes; rather, improvements have followed evolutionary and orderly lines with the result that changes have been slower than in some other industries. Only 3 per cent of the nation's bituminous coal was being mined without explosives or equivalent devices at the end of 1938. All except 16 per cent was being cut with machines, and of the underground production approximately 74 per cent was still being loaded in the traditional manner, hand shovels into mine cars.

Improved ventilating practices and rock dust have brought about a very substantial reduction in catastrophes. Notable progress has been made in curtailing the accident-producing hazards in the industry. The increased use of machinery has been and is reducing the frequency of injury-producing accidents. Likewise, the industry has continued its efforts towards improving housing, schools, hospitalization and recreation centers for its employees throughout the country. It has also directed its efforts strenuously towards improvement in safety measure for the protection of its employees.

(Continued on Page 142)

SILICA LICKED AT LAST ...WITH ALLIS-CHALMERS SILIMITE!

Allis-Chalmers Treatment Acclaimed by Power Plant Users Throughout the Country! Read How SILIMITE Can Defeat Your Biggest Enemy!

HERE IS PROOF that SILIMITE, the new Allis-Chalmers Silica Treatment, defeats one of the biggest enemies known to Chief Engineers.

SILIMITE removes silica externally in the conventional lime-soda softener. SILIMITE eliminates the need for additional expensive equipment. SILIMITE reduces silica from 35 ppm to below 2 ppm in treated water. SILIMITE'S low cost permits its use in every power plant with a silica problem. What's more, SILIMITE is field-tested . . . proven a success.

But don't take our word for it. Users write —

From a Southern Chemical Company: "The average residual silica in the effluent is now less than 2 ppm which has reduced the silica content of our boiler water by 95%."

From a Large Oil Refinery: "There is no further indication of silica deposits on the turbine blades since we have effectively reduced the silica with Silimite."

From a Mid-west Utility: "The effect of Silimite in reducing silica in our feedwater will permit us to proceed with our plans for high-pressure operation."

From a Southern Paper Mill: "The low cost of silica removal with Silimite and the ease of control make this process well adapted to our plant."

Don't fight a losing battle against silica. Write for complete details on the clean-cut, simple Allis-Chalmers SILIMITE method for eliminating the silica problem in your power plant. Feedwater Division, Allis-Chalmers, Milwaukee, Wisconsin.

A-1291

Over 90 Years of Engineering Superiority Work for You When You Specify Allis-Chalmers!

A-C

ALLIS-CHALMERS

MILWAUKEE · WISCONSIN

Because there's downright economy in using pipe unions again and again. And Darts are built to do exactly that. That means extra heavy bodies and nuts of air-refined malleable iron. It means two bronze seats, ground and matched to Dart's exclusive, "true-ball" surfaces . . . It takes this kind of quality to give you Dart's *multiple-service. So, if you want lowest cost-per-tight-joint,* buy Darts. You can't buy better unions.

DART UNIONS

E. M. DART MFG. CO., PROVIDENCE, R. I.

Sales Agents: The Fairbanks Company, New York, and all branches
Canadian Factory: Dart Union Company, Ltd., Toronto, Canada

The existing rates of wages are the highest being paid in any industry for labor comparable in skill or hazard of employment, and the hours of work are the shortest.

Green Pastures

AVERAGES, totals and percentages sometimes tell of conditions which are not realized by those too close to realities. What other people think of America and Americans may some day spell the difference between peace and war, for the haves and havenots are continuously contending for supremacy or the right to exist. From the London, England, paper "Sphere" the following quotation should give this country reason to think well of its opportunities.

"The United States contains 6 per cent of the world's area and 7 per cent of its population. It normally consumes 48 per cent of the world's coffee, 53 per cent of its tin, 56 per cent of its rubber, 21 per cent of its sugar, 72 per cent of its silk, 36 per cent of its coal, 42 per cent of its pig iron, 47 per cent of its copper, and 60 per cent of its crude petroleum.

"The United States operates 60 per cent of the world's telephone and telegraph facilities, owns 80 per cent of the motor cars in use, operates 33 per cent of the railroads. It produces 70 per cent of the oil, 60 per cent of the wheat and cotton, 50 per cent of the copper and pig iron, and 40 per cent of the lead and coal output of the globe.

"The United States possesses almost $11,000,000,000 in gold, or nearly half of the world's monetary metal. It has two-thirds of civilization's banking resources. The purchasing power of the population is greater than that of the 500,000,000 people in Europe, and much larger than that of the more than a billion Asiatics.

"Responsible leadership which cannot translate such a bulging economy into assured prosperity is destitute of capacity. But pompous statesmen, looking over the estate, solemnly declare that the methods by which it was created are all wrong, ought to be abandoned; must be discarded; that the time has come to substitute political management for individual initiative and supervision.

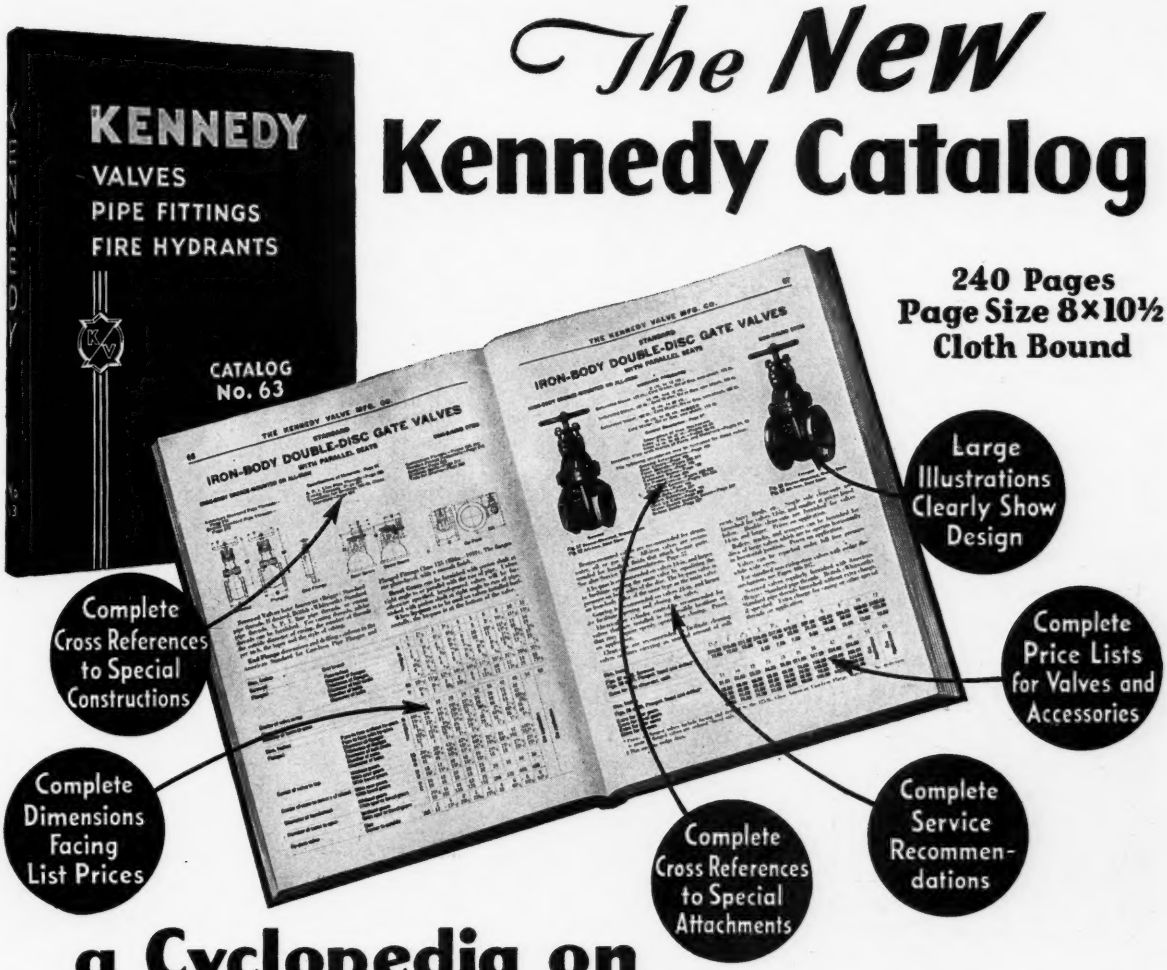
"There is only one way to characterize that proposal,—it is just damn foolishness."

Students' Views on Unionization

FOR SEVERAL years the question of unionization of engineers of the professional type has had considerable discussion among members of various societies. As a contribution to this discussion, John K. Bryan, a senior student at Purdue University, undertook a survey of the mechanical engineering students in his institution who were in their senior year to determine their attitude toward unionization. He presented the results of his findings in a paper at the A. S. M. E. Student Conference held in Chicago last April. This survey is significant in that it represents the views of young men who have chosen a course and

(Continued on Page 144)

The New Kennedy Catalog



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a Cyclopedia on Valves, Pipe Fittings, Fire Hydrants

You will find this new catalog a revelation in completeness — on details of design . . . specifications of construction . . . information on correct selection and application . . . accessories and attachments for individual operating conditions . . . and helpful engineering data on pipe lines, flow of fluids, etc.—all arranged for quick and convenient reference.

The valves and pipe fittings described and listed in this catalog include bronze and iron body designs for every standard requirement on steam, water, oil, air and gas lines, with sectional views and part lists for every type of valve. This catalog will prove a welcome aid in assuring the most suitable selection of valves and pipe fittings for your requirements. To obtain your copy, just fill in and mail the coupon, and be sure to do so TODAY.

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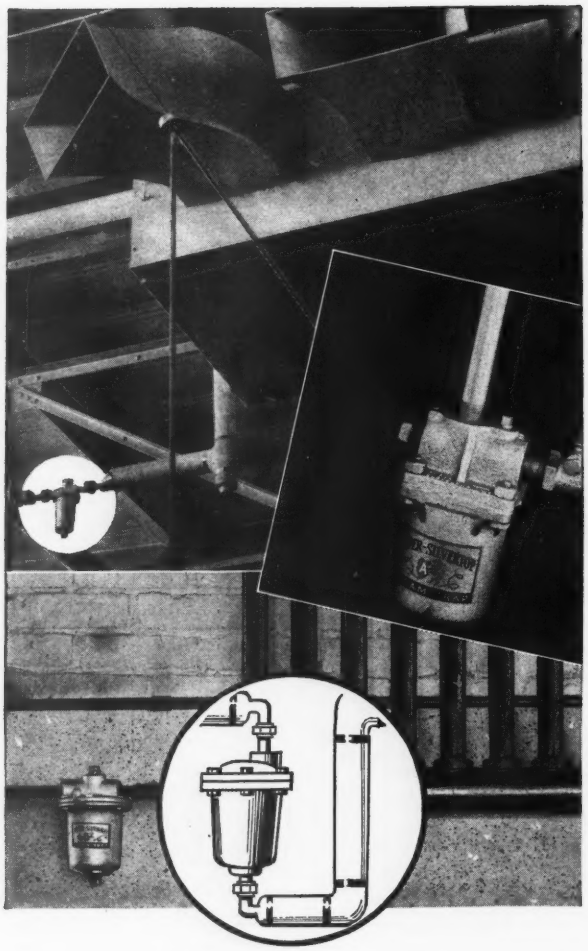

Why Use

DETOUR PIPING?

"Detour" piping is wasteful and out-of-date–but it was necessary with earlier forms of inverted bucket traps. Now, however, detour piping can be eliminated –eliminated by the use of Anderson Super-Silvertop traps. You save as much as 7 fittings and an hour of installation time per trap and get a neat, clean-cut piping job that you can be proud of. Connect this up-to-date trap either as an elbow or straight-in-line, no extra fittings to buy or install. Inspection is quick and easy–without disturbing pipe connections. Service life is long and trouble-free due to the guided bucket design and the Anderloy valve and seat used in Anderson Super-Silvertops. Get all the facts about steam traps and what size to use–send for your copy of "How To Choose a Steam Trap." Write today to

THE V. D. ANDERSON CO.
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Super-Silvertop STEAM TRAPS

prepared themselves for professional work but have not as yet entered the field. The following is an abstract of his paper:

The group as a whole is made up of 264 men, or 91 per cent of the senior mechanical engineering students at Purdue University, class of 1940. Their opinions, or prejudices, were obtained from their answers to 26 printed questions distributed to them. A majority of these students come from states other than Indiana, ranging all the way from New York to California. Over half of them are student members of some professional society, principally the A.S.M.E.

Before we can understand an engineering student's attitude toward unionization, we must know something about his attitude toward certain more fundamental matters: first, what does he believe is the place of engineering in our present social structure, and second, what is his reaction to the condition of engineers today.

So this question was asked: "After all, is engineering a profession, in the sense that one speaks of law and medicine as professions?" The answer is an emphatic *yes*. Eighty-five per cent are sure that engineering is a profession, while another 4 per cent are undecided. Only 11 per cent feel that engineering is *not* a profsssion in the sense indicated.

Fourteen out of every 15 senior mechanicals feel that engineers occupy a position of "public trust." About four-fifths of the group consider the engineer more closely allied to management than to labor, although several commented in the margins of their answer sheets that the engineer occupies a position *between* the two. But less than one-fifth feel that the engineer is more closely allied to labor than to management. As a final question in the first group, the students were asked, "Do you think that 'honor and recognition by fellow engineers' is as important to work for as a large salary?" Eighty-one per cent answer *yes*, and there is not a whole lot of indecision about the matter, either.

A definite correlation was found between students' answers to these first questions and grades. Thus the higher half of the class seems to have more of a professional or idealistic attitude toward engineering than the lower half.

Now, just why did these students go into engineering in the first place? Because they thought they could make more money in engineering than in other fields? Only 12 per cent give this as a reason. Because they like engineering work? Over 90 per cent give this as a reason.

Seniors are evenly divided on the question of whether or not the pay of engineers is, in general, lower than it should be. Sixteen per cent are undecided or don't know. Further, less than a tenth feel that the engineer must eventually resort to collective bargaining to secure fair wages and working hours.

From what has already been said, it is obvious what will be the students' answer to the question, "Are you in favor of the unionization of engineers?" Of the 264 students, 11 per cent reply *yes*, while 85 per cent answer that they are against unionization.

(Continued on Page 145)

Do you know that an old pump, seemingly faithful, can actually be in conspiracy to keep your power bills high?

If that pump is ten or more years old, regardless of condition, it is almost a certainty that it is costing you at least 10% more to operate than it should.

Today's Fairbanks-Morse Pumps of more efficient design, made by improved methods, actually pay dividends equal to 10% or more of the power cost of present obsolete pumps and pay additional savings in lower maintenance.

Why not investigate? Write Fairbanks, Morse & Co., Dept. 83, 600 S. Michigan Ave., Chicago, Ill. Branches and service stations throughout the United States and Canada.

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Fairbanks-Morse Centrifugal Pumps—a complete "family" of single-stage, split-case, centrifugal pumps for low, moderate, medium, and high heads, with capacities to approximately 6000 gallons per minute for heads up to 280 feet. Write for Bulletin 5810D.

Fairbanks-Morse builds the right type of pump for every job—and builds the *right type right.*

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DIESEL ENGINES ELECTRICAL MACHINERY RAILROAD EQUIPMENT WASHERS-IRONERS STOKERS
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help WARE HI-LAG Fuses save costly shutdowns

● When you install WARE HI-LAG Renewable Fuses you eliminate delays and expense caused by faulty or inadequate contacts. The WARE improved design, provides SPRING TENSION CONTACTS on both sides of fuse links, which insure greater contact surface and remarkable trouble-free performance.

Another money-saving feature of WARE Fuses is their exceptionally high time lag, which enables them to absorb momentary surges and overloads; this quality further guards against needless shutdowns.

WARE HI-LAG Fuses are fully approved by the Underwriters in all sizes for both 250 and 600 v.; from 3 to 600 amp. The new double-bridge assembly may be inserted either end first.

WARE BROTHERS
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Write for TRIAL TEST OFFER, Sizes and Prices

Analysis of the opinions of the student members of the A. S. M. E. shows an insignificant difference of only 3 per cent more favoring unionization. It was found that students whose fathers are union members feel the same way about this matter as does the class as a whole. This also holds for students planning to take graduate work next year. Of those students who by March 15th had been hired (this was about a third of the class) 13 per cent are in favor of unionization, showing that having or not having a job has little or nothing to do with a student's attitude toward this question.

Should the American Society of Mechanical Engineers and similar professional societies assume some of the functions of unions? One hundred thirty-two students say *yes*, 120 answer *no*. Student members of the A. S. M. E. are slightly more in favor of the Society's assuming some of the functions of unions. But only 60 students, 23 per cent, believe that the professional societies should establish codes of recommended pay for engineers, and try to enforce such codes.

Octane Number

WHEN you drive into the filling station some day ask the attendant to fill it up with octane number 80 gasoline as you are going to do some driving in the hills and don't want to be bothered with knocking. May be it should be number 75 or 85 for your engine, you had better find out although it would not make much difference for the attendant would probably say "Sure, that's our high test gas." This will prove to you that with the exception of the gasoline specialist and the automobile designer few people have any conception of the significance of the term. The Texas Co. in its publication *Lubrication* is the authority for the following statements telling how this term was derived and how the index is determined:

This is a term which is still possessed by an elusive meaning to the average motorist and even to many who are familiar with chemical research in industry. It has been accepted oftentimes entirely too casually, so it will be interesting to investigate the meaning. It pertains to elimination of knock in the gasoline type of internal combustion engine, or that noisy effect which is so detrimental to power output.

When the scientists began to consider ways and means to reduce this occurrence when sudden or extreme loads were applied in the automotive type of engine, a type of test engine was necessary. In this engine the anti-knock value of a gasoline is noted by matching its knocking tendency against that of a reference fuel of known anti-knock characteristics. The design of this engine duplicates as closely as possible standard automotive practice. The conditions under which this engine is operated and method of procedure used are also representative. They have been approved by the American Society for Testing Materials; the procedure is called the A. S. T. M.-C. F. R. Method.

The primary reference fuels in the operation of the test procedure are hydrocarbons known as iso-

(Continued on Page 148)

HOW Industrial Cleveland Squeezes EXTRA Power from Its Steam

with G-E Mechanical-drive Turbines

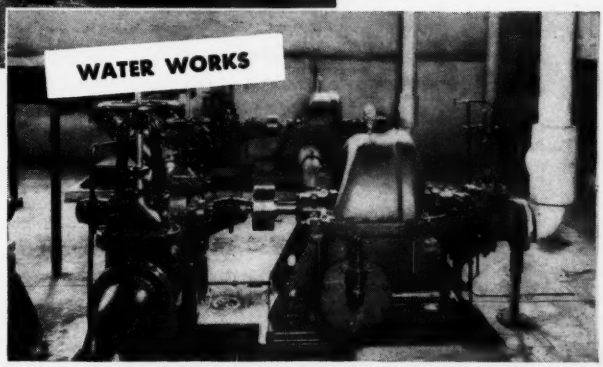
AS A USER OF STEAM, you'll be interested in the "squeeze plays" Cleveland industrial plants are applying to their steam systems to get additional power. Note the wide variety of applications. In the Cleveland area alone there are scores of G-E mechanical-drive turbines using available steam to drive pumps, fans, compressors, blowers, pulverizers, stokers.

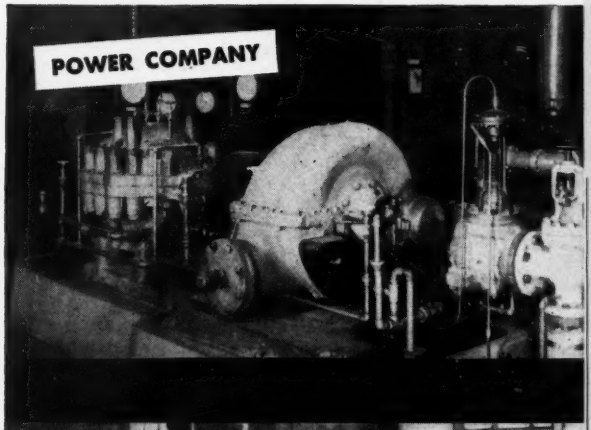
Two Ways That Turbines Get "Extra" Power

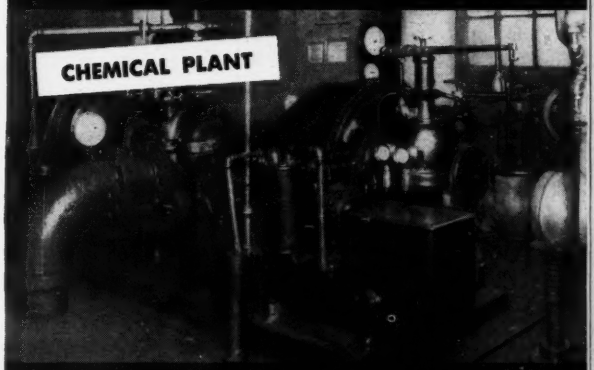
1. They do double duty—G-E turbines, as reducing valves, provide clean, low-pressure steam, and at the same time produce by-product mechanical power.

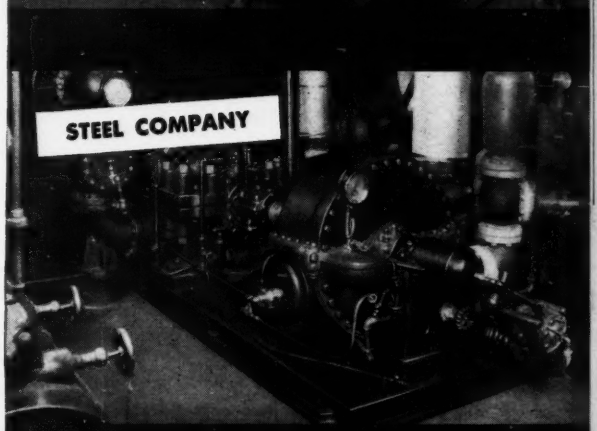
2. They utilize waste steam -- G-E turbines are built to get energy out of steam which you may be exhausting to atmosphere.

Ask our local turbine specialist to show how G-E mechanical-drive turbines can produce extra power for you. You may be able to save thousands of dollars. General Electric Company, Schenectady, New York.









GENERAL ELECTRIC

252-1

Are You Equipped to Hold Your Job?—to Get a New One?

The men who are keeping their jobs today—who are not feeling the whip of competition—are those who have kept one jump ahead of their jobs. They are the men who are equipped with a thorough-going and growing knowledge of the business they are in.

It works in the power plant field as well as in any other. Some men fit themselves to do a little more than their job calls for. They fit themselves to do a little more than the other fellow. They make a steady effort to equip themselves with the best kind of job insurance there is—KNOWLEDGE.

How about you? Do you know how quickly knowledge will pile up—how quickly you will become more valuable—if you spend a few minutes a day, regularly, studying sound books like the McGraw-Hill Library of Power Plant Practice? Do you know how easily it can be managed, paying only a few cents a day, while you use the books? Thousands of men have followed this plan to win advancement or to make their jobs safe. You can too. Read about this Library and our 10 Day Examination Offer. Then send the attached coupon to us today.

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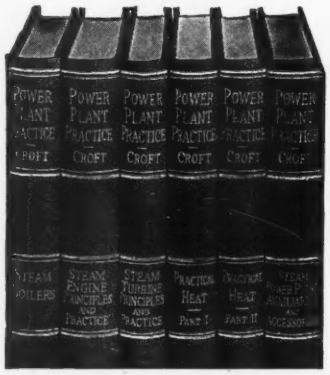

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octane with an arbitrary rating of 100 and normal heptane with an arbitrary rating of 0. By mixing the two a blend can be obtained with an anti-knock value equal to the fuel being tested. The resultant octane number is, therefore, the percentage of octane in this mixture of test fluids. In other words, it represents the relative proportion of iso-octane and normal heptane necessary to use in the test engine in order to get the same knocking characteristics as are obtained with the fuel being tested. Thus an octane number of "80" means that a mixture of 80 per cent of iso-octane and 20 per cent of normal heptane gives the same effect as the unknown fuel.

Steel at High Temperature

DEFINITE relationship exists between the structure of steel as revealed by a microscope and the amount it will creep or deform over a period of years in high-temperature use, it has been announced by S. H. Weaver of the General Electric turbine engineering department at Schenectady. As a result of his investigations the specifications used by the General Electric Co. in the purchase of certain special steels required in the construction of modern, high-temperature turbines include data concerning the structure and grain of the metal, as well as the more usual specifications concerning chemical analysis, physical properties at average temperatures, etc.

The phenomenon known as creep in metals is the slow deformation or plastic flow resulting at high temperatures from the application of stress over long periods of time—a modern steam turbine may operate at a dull red heat, with steam at 1000 deg. F. and at 1200 or more pounds pressure per square inch. Turbines, giants though they are, are precision built and close tolerances are demanded, so it is necessary to limit definitely the distortion which may occur in 10 or 15 yr. and to know which of the many different steel alloys will show the least elongation in service. To answer such questions a study of creep was begun 15 yr. ago in the G-E Research Laboratory. The work has yielded necessary design data and led to a great improvement in the selection of materials and their processing.

Creep tests necessarily consume much time. Long-time creep tests of several months' duration at high-temperature are hardly ever completed before that particular lot of steel is used in commercial production; short-time creep tests have been tried, but in general have not been satisfactory.

Mr. Weaver sought a method for indicating how any particular lot of steel would behave in high-temperature service. With the accumulation of data from creep tests in front of him he studied the structure of different steels. Studying carbon-molybdenum steel, one of the important alloys in turbine manufacture, he found that there is an optimum grain size of the metal which produces the maximum creep strength at each creep temperature. This method of predicting the creep strength, based upon the condi-

(Continued on Page 150)

TRY TUBE-TURNS

with Tube-Turn SLIP-ON FLANGES!

The word "Tube-Turn" is NOT a necessary general trade name for welding fittings. It is the registered trade-mark for the products made by Tube-Turns, Incorporated, under their patents.

● For good piping construction and lowest cost, use Tube-Turns with Tube-Turn Slip-On Flanges whenever flanged joints are required. You'll find that long radius, 1½R Tube-Turns work better with Slip-On Flanges than any other welding elbows because:

First: Tube-Turns, having uniform walls throughout with no excess thickening at the crotch, thus maintain an outside diameter that is extremely close to nominal. *Second:* Tube-Turns are made to such close tolerances that they always slip easily into the bore of slip-on flanges a sufficient depth to meet recommended practice and permit making a sound, strong joint.*

This is just one reason why, for completely dependable piping, it pays always to specify Tube-Turn Fittings and Flanges. The Tube-Turn line includes 90° and 45° Elbows, 180° Returns, Tees, Reducers, Caps, Lap-Joint and Shaped Nipples, Crosses, Laterals, Saddles, and all sizes, weights and types of Forged Steel Flanges. . . . Get all the facts, and a lot of valuable engineering data as well, from our new Catalog and Data Book No. 109. Ask your Tube-Turn Distributor for a copy, or write us direct. TUBE-TURNS, Incorporated, Louisville, Kentucky.

* In sizes below 4" it is impossible to use slip-on flanges on both ends of any stock fittings (Tube-Turns or others) because the flanges project too far to clear each other.

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Airetool's new series of power sealed motors emerged from careful experimentation and exacting tests under actual working conditions. Develops more power than any motor we have ever tested. Starts under heavy loads. Instant pick-up when air is applied. No dead centers. Constant torque at low speeds prevents stalling. Efficient operation at high speeds.

Airetool's New Series does not sacrifice the ruggedness or the simplicity of the previous Standard Series. Improvements are on the cylinder, rotor and rear head. No additional parts. No increase in air consumption.

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The new motors with their increased power now permit the use of a wider range of cutter head combinations. Such combinations will overcome extreme encrustations speedily and effectively, eliminating tube damage and metal removal.

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tions existing within the steel at room temperature, enables the consumer to judge the acceptance of a given requisition of steel and the designer to specify the steel with more confidence in the resulting product.

Mr. Weaver concludes that at the lower creep temperatures the finest grained steel has the greatest creep strength, at intermediate creep temperatures an intermediate grain size has the greatest creep strength, and that at the higher creep temperatures the coarsest grained steel has the greatest creep strength. He has found the maximum creep strength and the corresponding optimum grain size each varying as a continuous function of the creep temperature. The "grain size" refers to the effective grain as measured in terms of the size of the grains of ferrite, patches of pearlite or Widmanstätten areas, which ever predominates. Also, his conclusions are only with respects to steels differing only in their heat treatments, and otherwise having the same chemical composition, etc. Different grain sizes are obtained by heat treating at various higher-than-usual temperatures.

A uniform grain size is important, he reports. Steel deoxidized with a strong grain-growth inhibitor and finally heat treated in the coarsening temperature range often presents a "duplex" structure having areas of different grain size, with the creep strength of the steel weakened towards that of the weaker grain size. Other steels, presumably heat treated just over the A_{c_1} point (which is the beginning of the critical transformation temperature range), present grains with very irregular outlines, particularly between areas of ferrite and precipitated carbides, and have such low creep strength that they are unacceptable.

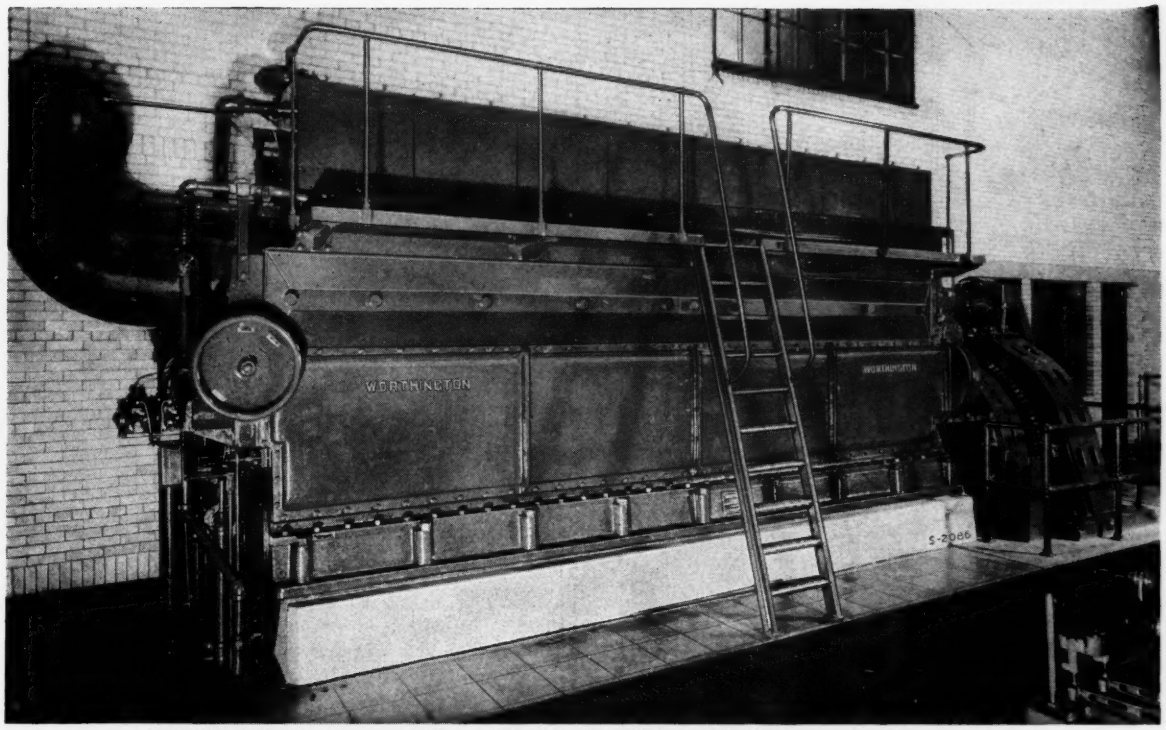
Developing Factory Workers

THROUGHOUT the industrial centers of the United States factory managers are having a difficult task in finding skilled labor to carry on the increased work which has come as a result of the program being carried out for strengthening the military defences of the country. About the only course open to many factories is to train their own staffs of workmen. While this may seem to be a long and almost impossible task, and unquestionably is in many trades, the majority of tasks in modern factories designed for mass production are of the one-piece variety, which can be learned in a comparatively short time of intensive training by men with even less than average mechanical skill.

Those familiar with modern factory work can readily understand how the training program described by an anonymous correspondent in a recent issue of the Boston Globe could be made to develop competent workmen for the emergency condition encountered today. It will, however, need the consent and cooperation of organized labor. His comments are quoted in the following paragraphs:

"During the World War, I was employed at a factory manufacturing airplanes. My job as foreman

(Continued on Page 152)



An 800-hp. Worthington convertible gas-Diesel engine, driving a 750 KVA generator. These units are built in sizes from 30 to 1800 horsepower, and are readily convertible, in a few hours, by means of a few parts, at low cost. They offer the advantage of the highest economy in fuel, either as gas or Diesel engines.

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BY installing a Worthington Engine *now*, you may effect power savings that will contribute materially to your future profits. In some plants, the savings have been more than 50% of former power costs.

It will cost you nothing to discuss *your* power problem with a Worthington engineer. If your particular conditions are not favorable to revision for improvement . . . if he cannot help you he will say so . . . but it is more than likely that you will draw from his experience some *profit-increasing* suggestions.

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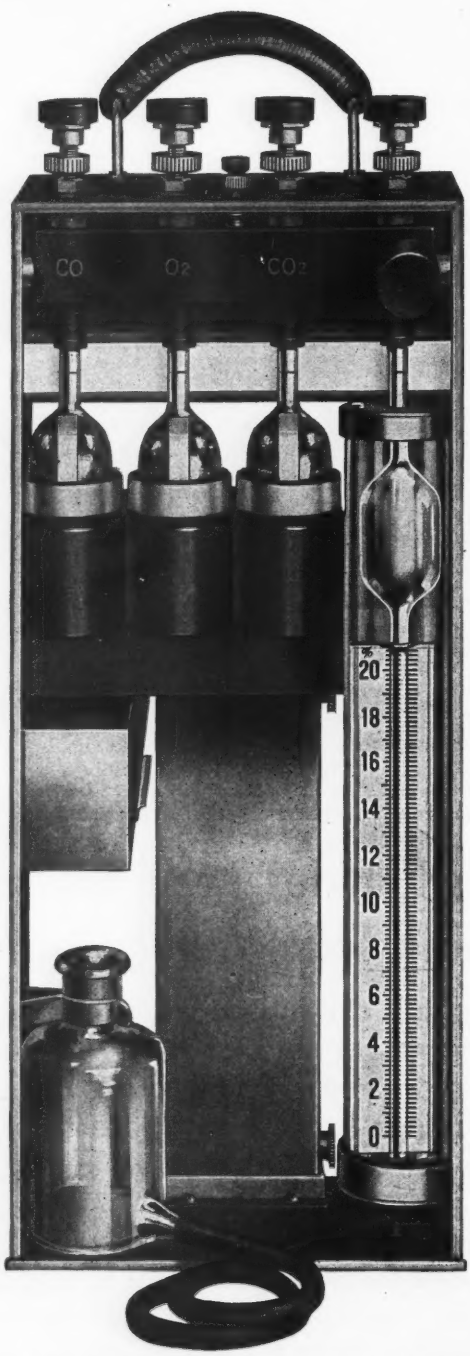
ELLISON GAS ANALYZER



A NEW DEPARTURE IN GAS ANALYZER DESIGN

Monel case 4x4½x18", covers removed, with or without draft gage sets and thermometers. Header and seats of hard rubber. Needle valve stems of corrosion-proof alloy, swivel joint. Pipettes filled with curled hard rubber. White panels in pipettes and back of capillaries. White scale, 7 to 8" long, compensated for "dead volume"—no error. Solution containers interchangeable. Gas line ⅛"—high speed sampling. Air seal, U type, trouble-proof. Burette jacket filled with glycerine, Monel cap top and bottom. Automatic or hand zero leveling. Accurate, durable and speedy.

"A Very Superior Instrument"

ELLISON DRAFT GAGE CO. 214 W. Kinzie St. Chicago

was to supervise the production of airplane parts, such as wings, ailerons, rudders, fuselages, etc. The labor situation was much worse than it is today. At that time airplanes were almost a novelty. Airplane mechanics were very few.

"The question arises in your editorial, 'Where are we going to get trained men?' The answer is that there are no trained men available. Train them in the factories. My method was to hire about 20 men, electricians, street car conductors, carpenters, paperhangers, painters, drugstore clerks, etc. I then formed a 'vestibule school' and in the corner of the factory started to train these men by first displaying the actual parts already made. Out of the first 20 men I got two promising prospects.

"Having taken these two prospects, I would do with them the actual assembling. The next day these two prospects were given charge of four men each and they acted as straw bosses over those men. Then I hired 20 more and followed a similar procedure. In about three weeks we had about 75 men actually assembling the parts. Out of those 75 there were five or six that could act as instructors for more newcomers, which left me free to supervise the construction of the parts. In about two months we had a crew of about 200 men and 35 girls, all turning out fairly good work. As time went on, the workmanship improved tremendously.

" 'Some industrialists feel that the large factories, when given production assignments, will be obliged to train their own new hands to a very considerable extent, although those who have come from brief courses in technical schools are likely to show up decidedly better than those lacking such preparation,' is, in my opinion, the key to the whole training problem.

"Men and boys who were high school and college graduates would be the best prospects. But if there are not enough of these men available, there are many hundreds on relief who could be trained."

Somewhat the same line of training is suggested by George T. Trundle, Jr., president of the Trundle Engineering Co., in the official publication of the Central Manufacturing District. He thinks it takes at least 4 yr. of apprenticeship and many more of varied experience to make a real skilled mechanic. "We cannot wait to teach men to do any work on any machine. We must teach hundreds of thousands of men how to do one job on one machine," he says.

"This does not take years or even months. It requires only four to six weeks, if it is done in the right way by the right instructors. Now we approach the point of what might prove to be the bottleneck. The highly skilled men in industry are the very ones we need for the training of new men. Today, unfortunately, our highly skilled men are too busy operating machines to be spared to train new men. This must be changed. Somehow we must switch more skilled men from operating to teaching. How are we to do it?

"First—many thoroughly skilled mechanics now operate automatic or semi-automatic machines which

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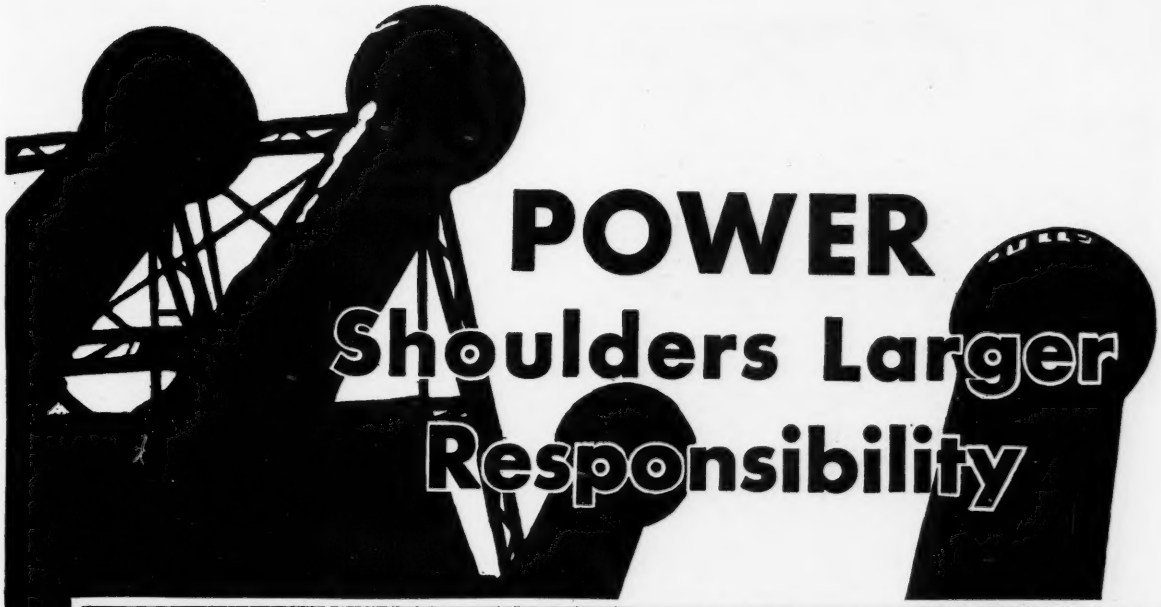

POWER Shoulders Larger Responsibility

Squarely on America's industries rests the success of this Nation's ability to thwart any threat to our peace and prosperity. Back of every preparedness step that Industry will take is the need for Power, for without modern power facilities every defense effort becomes futile.

In these conditions, this year's National Power Show assumes added importance. Here, under one roof, engineers can, in one short week or less, see the latest products...discuss needs and problems with engineers in attendance at exhibits . . . view demonstrations . . . discuss, compare, and select the latest and best equipment, materials, instruments, supplies and services for efficient power and steam generation, control, transmission and application.

Here, engineers alert to their responsibilities and opportunities will contact manufacturers to make sure that plant capacity can be increased as fast as required, and avoid production-clogging bottle-necks when prompt deliveries are no longer possible.

Admission is by registration.

More than 40,000 visitors are expected.

Engineers and executives with power interests are invited.

14th NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING . .

GRAND CENTRAL PALACE · NEW YORK · DEC. 2-7, 1940

Management, International Exposition Co.

This is the 1940 Richardson Automatic Coal Scale of all welded construction—basically the same unit that has been saving labor and giving 99¾% accurate records of coal consumption in thousands of power plants for many years. Now it is equipped with an outer sheathing for streamlined appearance that blends with the most modern boiler room interior. In addition the new sheathing protects the weighing mechanism against tampering, and dust in the air outside the scale. The all welded dust-confining housing separates weighing mechanism from dust and moisture in the coal being weighed, and further improvements are a larger inlet spout, and the use of stainless steel for all parts which come in contact with the coal.

Where crushed or pulverized coal—wet or dry—is used as fuel, the Richardson Automatic Coal Scale offers the most accurate, economical known means of keeping boilers under continuous test.

Write for Bulletin R-6239.

RICHARDSON

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RICHARDSON SCALE COMPANY, CLIFTON, N. J.

567

could be run, after a minimum of instruction, by less skilled men. Let us put the newer and younger men to work on these automatic and semi-automatic machines, and thereby free more of the older, highly skilled men to act as instructors.

"Another method is to combine production and teaching. Suppose a highly skilled man, now operating a certain machine, takes a novice under his tutelage. The job of the older man is to teach the younger man how to operate the machine without interruption of, or interference with, its continuous operation. A single pupil under a skilled tutor can make extremely rapid progress. Within a few weeks the older and experienced operator of the machine can turn it over to his young pupil and immediately begin to teach exactly the same thing to another young man. I have seen this method put into operation and watched it work in a number of plants. I know it is practicable.

"The only way in which men can be taught how to run machines is by actually putting them to work at those machines on the floors of the industrial plants of this country. There is one exception. Thousands of boys are enrolled in technical courses in our high schools. If the industries of each city would supply these schools with machines and materials, the boys in these classes might obtain at least a start toward the practical production experience needed for employment in their own communities."

New Clue for Oil Explorers

GEOPHYSICISTS in searching for oil, believe gamma rays, radiated by the varying rock formations thousands of feet under ground will provide a tool for finding more than enough oil to meet increasing demands for petroleum products.

Oil-well logging by radioactivity, which transmits accurate measurements of these gamma-ray radiations foot by foot down through the well for exact recording on the surface, may open up new vistas of oil discovery. Records of wells that already have been cased with pipe can be taken. This characteristic, it is hoped, will make it possible to find oil formations at other levels in old wells and fields.

Extent of such previously-missed formations is unknown, but it is believed that many wells were drilled which completely overlooked valuable formations, or noted them so inaccurately that they could not be found again readily.

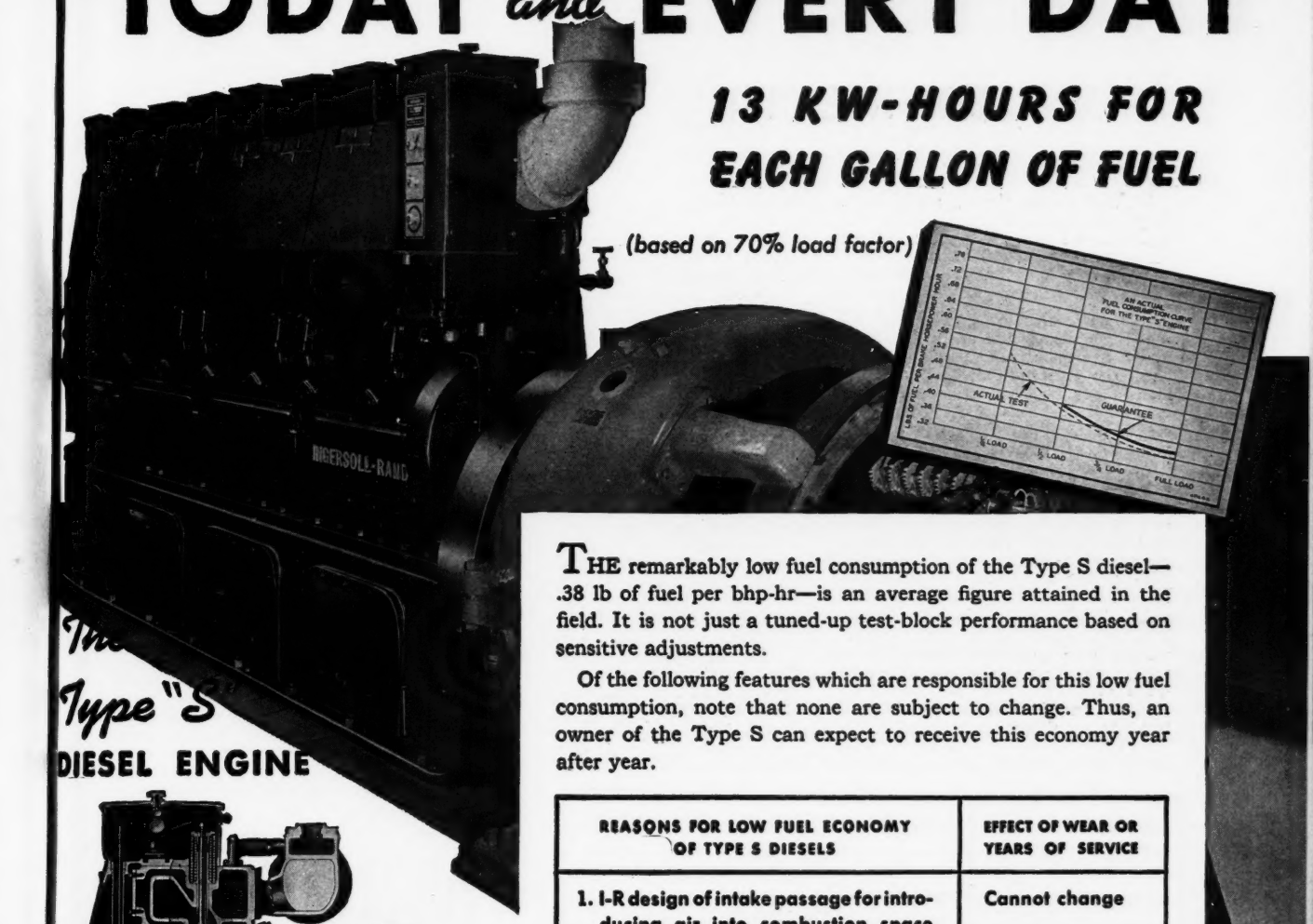
Radioactivity logging works because every substance is in some degree radioactive. With the development of modern methods of amplifying and measuring these rays, it has become possible to chart variations in ray intensity from rock formations down through a well. Gamma rays, rather than the more familiar alpha and beta rays, are measured because they have short wave lengths and can penetrate iron pipe.

Added to the magnetometer, the torsion balance, the seismograph, the mass spectograph, the electric log, the core barrel, the aerial camera, and the host of other recently-developed oil-exploration instruments and techniques, well-logging by radioactivity is further proof that America's oil men will continue to find oil for years.

TODAY and EVERY DAY

13 KW-HOURS FOR EACH GALLON OF FUEL

(based on 70% load factor)

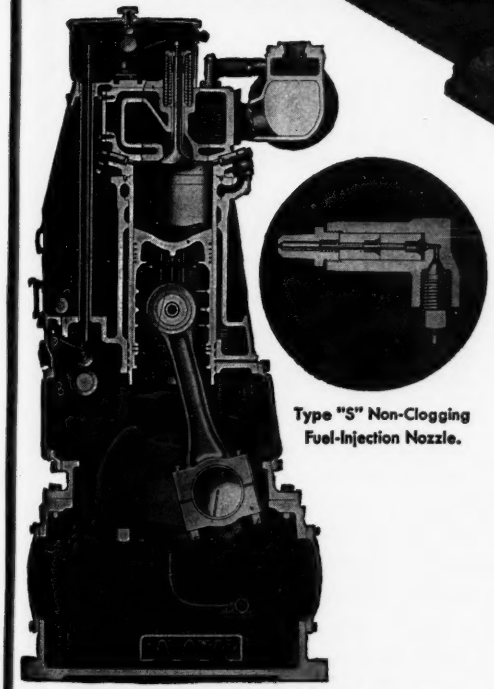


The Type "S" DIESEL ENGINE

THE remarkably low fuel consumption of the Type S diesel—.38 lb of fuel per bhp-hr—is an average figure attained in the field. It is not just a tuned-up test-block performance based on sensitive adjustments.

Of the following features which are responsible for this low fuel consumption, note that none are subject to change. Thus, an owner of the Type S can expect to receive this economy year after year.

REASONS FOR LOW FUEL ECONOMY OF TYPE S DIESELS	EFFECT OF WEAR OR YEARS OF SERVICE
1. I-R design of intake passage for introducing air into combustion space	Cannot change
2. Shape of combustion chamber	Cannot change
3. Special return valve which prevents pressure waves in the injection piping . . . eliminates fuel dribble into combustion chamber.	This simple, long-life valve operates in cold oil . . . not sensitive to wear
4. Arrangement of two injection nozzles—diametrically opposed.	Cannot change
5. Type of injection nozzle having one large non-clogging hole.	* No change



Type "S" Non-Clogging Fuel-Injection Nozzle.

It is an easy job to keep the Type S engine in first-class mechanical condition. It is a 4-cycle, heavy-duty engine rated and built for continuous full-load service. It has refined, automatically lubricated valve mechanism.

6 sizes from 190 to 510 bhp at 600 rpm; 3 to 8 cylinders; 10½" bore, 12" stroke.

* Injection nozzles are usually considered the most troublesome part of a diesel engine. *In the Type S, however, there just isn't ANY trouble with the nozzles.* They stay in their original condition without adjustment or cleaning.

Each Type S nozzle has a single-hole opening that does not clog. Normal wear and enlargement of this hole have practically no effect on engine performance. Two free-operating check valves shut off injection instantly and prevent dribbling. There are no lapped-in plungers to stick, and no outside drainage lines from the nozzles.

Send for your copy of New Bulletin 10,210. It illustrates the other valuable features of the Type S.

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Detroit
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El Paso
Hartford
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New Engineering Books

FLASH! Seeing the Unseen by Ultra High-speed Photography. By Harold T. Edgerton and James R. Killian, Jr. First edition. 203 pages, 8½ by 11 in., cloth. Published by Hale, Cushman & Flint, Boston, Massachusetts, 1939. Price, $3.00.

Although this book was designed largely for its popular appeal, it should be of tremendous interest to engineers and technicians, not only for its general interest but for its value in suggesting uses for the methods of photography described in their own work. No engineer needs to be told about the stroboscope. To a limited extent it has been used in industry and engineering research for many years. Dr. Edgerton's stroboscope, however, is quite different and infinitely more flexible and effective than earlier types and the occasional photographs taken by him and which have been published in newspapers and magazines have made all of us sit up in astonishment. Those who have seen some of these remarkable photographs will know what we mean. This book is a collection of hundreds of such photographs. Here we see, for example, what happens when a bullet passes through a light bulb. We can see the bullet approaching, inside and leaving the bulb as the glass slowly starts to fall apart. We can see a humming bird hovering with stilled wings that beat (we know now from these pictures) at the rate of 60 to 70 times per second. We can watch a drop of milk hit a plate and in so doing take the shape of a lovely coronet.

As the authors point out, such pictures are not merely stunts to capture the interest of the average person. When we can "freeze" motion to less than one millionth of a second, we open up a whole new field of investigation into the behavior of material and process under varying conditions. In the design of machinery, the analysis of motion by means of the Edgerton stroboscope has proved invaluable. During the 15 years that Dr. Edgerton has been developing his methods he has brought his apparatus to a state of perfection where others can use his methods. New possibilities are opened up in every direction and the engineering mind, particularly, will find a fertile field for actions in the use of this equipment. To say the least, Flash is an unusual and fascinating book.

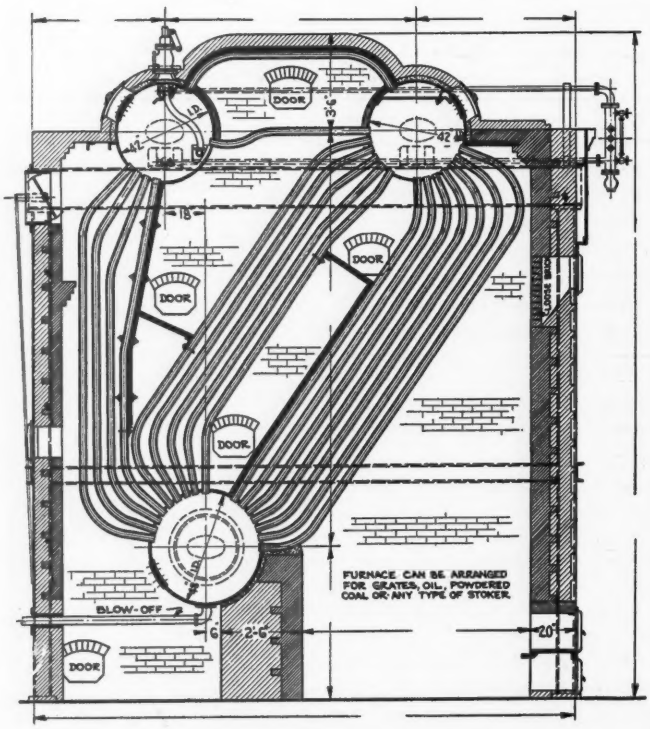
Typical Specifications for Surface Condensers and Auxiliaries for Turbine Service is an 8 pp. booklet prepared by the Heat Exchange Institute, 90 West Street, New York, N. Y., as a guide to purchasers of surface condensers, to insure that complete information is supplied by purchasers to manufacturers. Copies are included in each order of the Institute's Standards of the Condenser Section, price $1.00 per copy. The Specifications themselves may be purchased separately at a cost of twenty-five cents (25c) per copy.

WILEY TRIGONOMETRIC TABLES. 81 pages, 5½ by 8½ in., cloth. Published by John Wiley & Sons, Inc., New York, N. Y., 1940. Price 75 cents.

This volume contains the following mathematical data. 1. Squares and square roots. 2. Constants with their logarithms. 3. Natural Logarithms of Numbers. 4. Five-place logarithms of numbers. 5. Logarithms of functions. 6. Four-place values of functions and radians. To those wishing pertinent mathematical data in convenient, compact form, this volume fills the requirements at a low price.

GENERATION AND TRANSMISSION. By C. S. Beckett. First edition. 118 pages, illustrated, size 5½ by 8½ in. Cloth. Distributed by Chemical Publishing Co., Inc., 148 Lafayette St., New York, N. Y., 1940. Price $2.00.

This book is one of a series of small volumes on the general subject of Electrical Engineering, published by Blackie & Son, Ltd. It deals with both the steam and electrical sides of a modern generating station and also with the transmission of electrical energy by overhead line and underground cable. The first six chapters are concerned with Generation and the last five with Transmission. The treatment is simple with many numerical examples and with many excellent diagrams.



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Aluminum Pistons and Cylinder Heads is the title of a 44-page paper bound book prepared by the Dynamic Laboratory of the Aluminum Company. This book is divided into four chapters covering types of pistons, their design, metal composition for various types of engines and different services, piston finishes and notes on the design, materials, manufacture and machining of cylinder heads. The booklet is distributed free of charge by the headquarters of the Aluminum Co. of America, Pittsburgh, Pa.

Technical Drafting. By Charles H. Schumann. Published by Harper & Brothers, New York. Size 6 by 9 in.; 736 pp.; cloth bound. Price $3.50.

While there are many good books on drafting, this is probably the most complete and comprehensive of all, for it is intended not only as a textbook but as a professional reference book for engineers and architects. It is divided into 30 chapters, the first section covering instruments and materials, the use of drafting equipment, lettering, different geometrical constructions, engineering drawings and drawing technique. This last covers different kinds of projections as well as conventional drafting technique and standards.

The second part deals with professional drafting, with particular emphasis on the requirements of machine design, mechanical, industrial, welding, chemical, electrical, civil and mining engineering drafting, etc. The last few chapters of this section cover the construction of graphs, architectural drafting, shading, topographical drafting, duplication of engineering drawings and a 15-page chapter on the slide rule and its use. In addition to the book proper there is an appendix of 38 pages of tables and different industrial standards. The author is associate professor and executive officer of the Department of Drafting, Columbia University.

Local Protection Project, Newark, Ohio, is the title of a 20-page planographed book prepared by the United States Engineering Office, Huntington, W. Va. This flood protection work, centering about the junction of the North and South forks of the Licking River at Newark, involves a water shed of approximately 780 sq. mi. It involves widening, deepening and straightening the channels, construction of levees and a pumping station. The total cost is around three-quarters of a million dollars. Contract for the work was awarded to Midland Constructors of Chicago, Ill., recently and is expected to be completed by September, 1941.

Resistances. A new comprehensive 96-page Industrial Catalog and Engineering Manual has been issued by the Ohmite Mfg. Co. This book, more than a catalog, contains helpful facts and information on the selection and application of Resistors, Rheostats, Tap Switches, Chokes, and Attenuators. It contains a wealth of engineering data, handy reference tables, dimension drawings, illustrations, special guide pages, and a manual of resistance measurements—all clearly defined and arranged as to make it easy to select proper stock units or to plan special made-to-order units for any application.

Copies of the Ohmite Catalog 40 will be sent to engineers, production managers, purchasing agents or executives who send in their names on company stationery, stating their positions.

Steam, Air and Water Equipment, a new 80 pp. composite catalog published by the Johnson Corp., Three Rivers, Mich., bound in convenient looseleaf style so future additions and revisions can be inserted easily to keep the book up-to-date. A handy index arrangement breaks up this new catalog into five sections, each of which describes in complete detail one of the various types of Johnson products: the rotary pressure joint; the pressure equalizing pump; the boiler water level control and the Johnson-Gast air and steam separators, oil absorbers and aftercoolers.

MELLON INSTITUTE of Industrial Research, University of Pittsburgh, Pittsburgh, Pa., is distributing, free of charge, a 20-page illustrated booklet entitled "Refractories Investigations in Mellon Institute." This booklet gives a short history of the refractory fellowship, describes briefly some of the research program that has been carried on, and shows photographs of the laboratories and research equipment.

PROTECTING EYES IN INDUSTRY. This is the title of Bulletin No. 36 issued by the United States Department of Labor and for sale by the Superintendent of Documents, Washington, D. C., at 5c per copy. It is an 18-page booklet containing addresses presented before the Industrial Section, National Society for the Prevention of Blindness, at its annual conference in New York City, Oct. 27, 1939. A foreword by Verne A. Zimmer, the director of the Division of Labor Standards is included.

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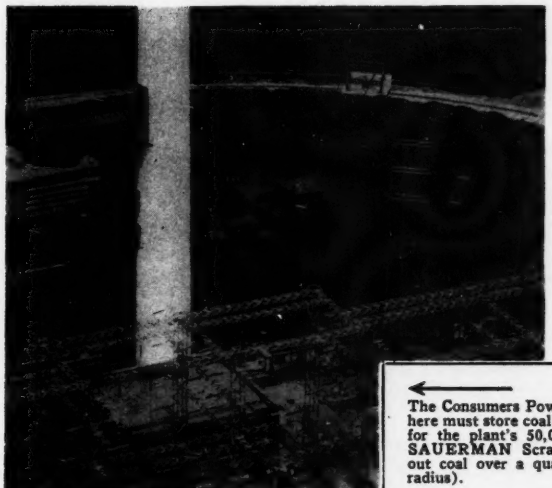

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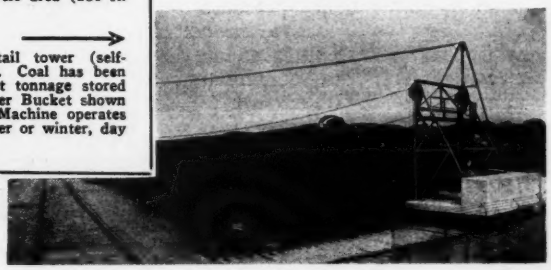
← The Consumers Power Company plant shown here must store coal to assure a steady supply for the plant's 50,000 K.W. generators. A SAUERMAN Scraper is at work stocking out coal over a quarter circle area (280 ft. radius).

→ Right is the travelling tail tower (self-propelled) of Scraper unit. Coal has been piled 27 ft. high. Greatest tonnage stored to date 38,500 tons. Scraper Bucket shown is 2½ cu. yd. capacity. Machine operates with equal efficiency summer or winter, day or night.

● Truly, the unusual advantages of SAUERMAN Drag Scrapers cannot be duplicated with any other type of coal storage equipment.



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Fundamentals of Electricity and Electromagnetism. By Vernon Andrew Suydam. First Edition. 690 pages, illustrated, size 6 by 9 in. Cloth. Published by D. Van Nostrand Co., Inc., 250 Fourth Ave., New York, N. Y., 1940. Price $4.75.

This is a most excellent book, indeed, among the many fine books on electricity that have been published in recent years, this volume ranks easily as one of the best. It is well written, comprehensive, logical in its arrangement and sincere. A number of years ago the reviewer wrote a small book on this subject and had the audacity to call it "Electricity—What it is and How it Acts." Recently, another book appeared on the market under the title, "Electricity—What it is Not" or something to that effect. Strangely enough, these two books with quite opposite titles are not widely different—both cover essentially the same ground and in each case, the reader is left with the same final impression—he still does not know what electricity is. Such trick titles, designed largely to stimulate attention do not add anything to the basic value of the books. Mr. Suydam, who is Professor of Physics at Beloit College, does not have to seek recourse in trick titles. His title for his book is sincere and honest. Fundamentals of Electricity and Electromagnetism—what could be more explicit. His first chapter, What is Electricity, though it asks the question makes no pretense of answering it, it is essentially an historical introduction to the subject. As he points out at the end of this first chapter, the ultimate nature of electricity and magnetism is still beyond our ken. We formulate theories and construct mental images in our endeavor to understand the ultimate realities of nature, but we are not sure that our subjective pictures coincide with objective reality. The laws and principles governing these unknown entities are definite and, for the most part, well known and it is with these laws and principles that the book is directly concerned.

It must not be assumed that this book is a treatise on practical electrical engineering. No details of equipment or construction are presented. The principles underlying the design and construction are, however, covered in great detail and it is from that standpoint that the engineer will find this book of value. The book will serve well the purpose of providing a solid foundation upon which the electric power and the communication engineer may build. It should be of equal value, however, in other fields, medicine for example, where electrical methods of measurement and electrical processes find application.

The author takes full cognizance of the knowledge that has accumulated regarding the electron. The way in which the properties and action of the electron underlie all branches of the electrical art is explained and its numerical relatoinships to the classical laws of electrostatics shown.

Throughout, the book presents quite a different approach. As the author points out, the book is a development born of necessity rather than a special creation by design. During the course of many years of teaching, the author's lecture notes were systematized and amplified and now they have been put into book form. They have been tested and modified by actual class instruction to such an extent that, as Mr. Suydam puts it, there is ample justification for *another* book with a different emphasis and a different method of treatment.

Specifications. The Edison Electric Institute, 420 Lexington Ave., New York, has issued two 4-page bulletins covering suggestions for specifications. Bulletin MS-2, 1940 is entitled Suggestions for Specifications for Coordinated and Standardized Low Voltage Metering Current Transformers. The other Bulletin, MS-1, 1940, is entitled Suggestions for Specifications for Standard Dial Constants for Alternating Current Watthour Meters. These bulletins are both of a series issued by the Meter and Service Committee of the E. E. I. and are intended to be used by member companies as an aid in preparing their own standard specifications for the purchase and use of meter equipment. Copies can be purchased at 10c each.

Simple Blue Print Reading with Special Reference to Welding, size 6 by 9 in., 138 pages, 164 illustrations, simulated leather cover; published by The Lincoln Electric Co., Cleveland, O., 1940. Price 50 cents postpaid in U..S. A.

While being compiled primarily for welders, this book affords a basic study of blue print reading and information dealing with mechanical construction. Allowing the individual to test his knowledge, a list of questions and answers are included in the text.

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Boiler Inspector's Manual. By C. C. Custer. First Edition. 111 pages, illustrated, size 8½ by 11 in., planographed. Paper cover. Published by C. C. Custer, 1012 Michigan Ave., Logansport, Ind. 1940. Price postpaid $3.00.

Although the title of this book implies it to be a manual for the boiler inspector, it is more than that and will be found of value to any boiler operator. Essentially, it is a collection of various articles written by the author and published from time to time in Power Plant Magazines, including POWER PLANT ENGINEERING, but a considerable amount of new material has also been added. All of it is material of practical value and while the presentation of the subject matter could be more logical and orderly, this does not detract from the fundamental value of the material. The author has had many years of practical experience as a boiler inspector and he talks the language of the man in the plant.

TROUBLES OF ELECTRICAL EQUIPMENT. By H. E. Stafford. Second Edition. 373 pages, illustrated. 6 by 9 in. Cloth. Published by McGraw-Hill Book Co., Inc., New York, N. Y., 1940. Price $3.00.

This book covers the symptoms, causes and remedy of troubles of both a.c. and d.c. apparatus usually found in the average industrial plant. It represents the cumulative experience of the author's over thirty years' work as an erecting, maintenance and consulting engineer. Almost every chapter also includes priceless hints on efficient operation and maintenance. It is a practical, how-to-do-it book that will prove indispensable to the electrical maintenance man or in fact, to any man having electric power equipment in his care. Many excellent diagrams are included and all formulas are illustrated by practical examples. Technical terms are explained in everyday English.

Piston Rings. The Double Seal Piston Ring Handbook for Engineers (Third Edition) is being distributed by the Double Seal Ring Company, Ft. Worth, Texas. This attractively bound 70-page book forms a condensed source of practical information for engineers, machine operators and designers, covering specifications, applications and recommended types of piston rings. It is priced at $1.00.

Strength of Materials. Part I, Elementary Theory and Problems. By S. Timoshenko. Published by D. Van Nostrand Co., Inc., 250 Fourth Ave., New York City. Size 6 by 9 in.; cloth bound; 354 pages. Price $3.50.

Since its appearance in 1930, this book has been recognized as almost a classic text of the new technique for the solution of technical problems, that is the change in the attitude of designers toward the application of analytical methods instead of empirical formulas, and the application of these analytical methods combined with laboratory experiment in practical design.

Unfortunately, the text was so technical that it was of practical service only to graduate students and research engineers. This second edition rectifies this and the book has been largely rewritten in an effort to adapt it to the teaching requirements of schools. A considerable portion of the more advanced material used in the previous edition has been removed and will be included in the second volume.

The new volume I is divided into ten chapters covering tension and compression, stress and strain, shearing force and bending moment beams of different types, columns, torsion and energy of strain. Application of the theories presented are illustrated by a large number of problems added to the text, in some cases with the answers only given, in other cases with a complete solution of the problem making the book doubly interesting and valuable to those interested in it for home-study purposes or as a reference book in their library.

Paint. The Maintenance Painting Handbook, a 128-page book of information on painting, published by the Industrial Paint Clinic of the American-Marietta Co. It is a comprehensive guide in the solution of all sorts of paint problems and represents the accumulation of reports and records of technical paint questions extending over a period of 27 years. The findings in more than 100,000 actual cases have been compiled to give the results of first-hand experience with paint problems. It contains complete descriptions of surface preparation, methods of paint application, and types of paints that have proved successful under widely varying conditions. Included in the manual are concise discussions of painting methods for protection against weather, radical temperature changes, climate, moisture, acids, fresh and salt water, smoke, chemicals, dust abrasion and many other hazards to industrial painting. The handbook will be distributed free of charge to industrialists and paint buyers.

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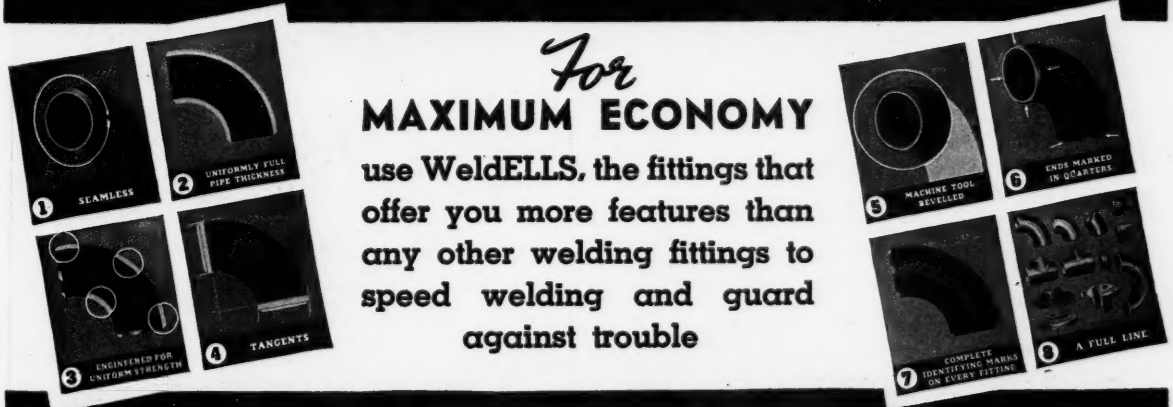
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Power Plant Construction News

Calif., Burbank—Lockheed Aircraft Corporation, Victory Place, manufacturer of airplanes, plans installation of electric power equipment in new additions to plant, comprising several one-story units for large increased capacity. Entire project will cost over $1,500,000. Work will be placed under way at once.

Calif., Oakland—Bureau of Yards and Docks, Navy Department, Washington, D. C., is asking bids (no closing date stated) for refrigerating equipment for plant at Fleet Supply Base, Oakland, including ammonia compressors, brine coolers, refrigerant receivers, evaporative condensers, brine and ammonia pumps, cold storage room piping system, and auxiliary equipment (Specifications 9977).

Ga., St. Marys—St. Marys Kraft Corporation, care of Gilman Paper Co., Gilman, Vt., Charles Gilman, vice-president, recently organized as an interest of latter company, plans installation of electric power equipment in new pulp and paper mill in vicinity of St. Marys, using 80-acre tract of land, lately acquired. A power house and pumping station will be built. Entire project estimated to cost over $1,000,000. Proposed to begin work soon.

Ill., Chicago—Dixie-Vortex Co., 421 North Western Avenue, plans installation of electric power equipment in new six-story addition, 60x120 ft., to paper cup and container plant. Entire project reported to cost over $200,000. Work will begin soon. Niestadt & Love, 343 South Dearborn Street, are architects.

Ill., Marion—Construction Division, Veterans' Administration, Washington, D. C., will receive bids until Oct. 8 for one-story boiler house (about 150,000 cu. ft.) at institution at Marion, including boiler units and auxiliary equipment. Also for elevated steel tank and tower, capacity 200,000 gals. Work will be carried out in conjunction with other buildings, for which bids will be received at same time.

Ind., Indianapolis—Radio Corporation of America, Inc., 30 Rockefeller Plaza, New York, N. Y., plans installation of electric power equipment in four new additions to branch plant at St. Clair Street and Belt Railway, Indianapolis, used for manufacture of radio apparatus. Entire project reported to cost over $450,000. Work will begin soon. J. N. Smith is resident vice-president.

Ind., Richmond—Board of Public Works, City Hall, has plans maturing for extensions and improvements in municipal power plant, including installation of new 15,000-kw. turbine-generator unit and accessories, condenser, switchgear and miscellaneous equipment. Cost estimated about $825,000. John W. Mueller, 42 South Ninth Street, is consulting engineer.

Ind., South Bend—Bendix Aviation Corporation, manufacturer of wheels, brakes and other aircraft parts, plans installation of electric power equipment in new addition to local plant, to increase present production facilities about 25 per cent. Entire project is reported to cost over $1,500,000. Work is scheduled to begin soon.

Iowa, Osage—City Council has plans maturing for new municipal power plant, using Diesel engine-generator units and accessories. Cost estimated about $325,000, and special election has been arranged to vote funds in that amount. Hubbard Engineering Co., 80 East Jackson Boulevard, Chicago, Ill., is consulting engineer.

Kan., Clay Center—City Council is asking bids until Oct. 9 for extensions and improvements in municipal power plant, including installation of new steam turbine-generator unit, condenser, boiler and auxiliary equipment. Cost estimated about $150,000. Burns & McDonnell Engineering Co., 107 West Linwood Boulevard, Kansas City, Mo., is consulting engineer.

La., Bogalusa—Gaylord Container Corporation, Pulp and Paper Division, 2820 South Eleventh Street, St. Louis, Mo., plans installation of electric power equipment in proposed new additions to pulp and paper mill at Bogalusa. Company is arranging financing in amount of $5,000,000, considerable portion of sum to be used for purpose noted.

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Md., Baltimore—Glenn L. Martin Co., Middle River, manufacturer of aircraft, plans installation of electric power equipment in new addition to plant, totaling about 400,000 sq. ft., for production of large bomber airplanes. Entire project will cost in excess of $2,500,000. Company also plans several other plant additions in near future, to represent a total investment of more than $20,000,000.

Mass., Worcester—Heald Machine Co., New Bond Street, manufacturer of machine tools, has approved plans for new steam power house at plant. Cost estimated over $80,000 with boiler units, pumps and auxiliary equipment. Work is scheduled to begin at once. Albert Kahn Associated Architects & Engineers, Inc., New Center Building, Detroit, Mich., is architect and engineer.

Mich., Dearborn—Ford Motor Co., Dearborn, plans installation of electric power equipment in new plant, in vicinity of present works, for production of airplane engines, consisting of several large one-story units. Entire project will cost close to $10,000,000, and is scheduled for completion next spring.

Mich., Detroit—General Chemical Co., 40 Rector Street, New York, N. Y., manufacturer of sulphuric acid and other heavy chemicals, plans installation of electric power equipment in new branch plant near junction of Detroit and Rouge Rivers, Detroit. A boiler house will be built. Entire project is reported to cost over $500,000. Work will be placed under way at once. Company is a subsidiary of Allied Chemical & Dye Corporation, 61 Broadway, New York.

Mich., Marshall—Electric Light and Water Commission plans expansion and improvements in municipal power plant, including installation of new Diesel engine-generator unit and auxiliary equipment. Cost estimated close to $100,000. Proposed to carry out work soon.

Mo., Kansas City—W. S. Dickey Clay Mfg. Co., New York Life Building, manufacturer of sewer pipe, drain tile and other clay products, plans installation of electric power equipment in new plant on local site at Monroe and Guinotte Streets, consisting of several one-story units. Proposed to begin work early in 1941. Entire project reported to cost over $350,000.

Mo., Nevada—City Council has plans maturing for new municipal electric power plant, with initial capacity of about 1500-kw. Cost estimated about $490,000, with equipment. Special election is being arranged on or about Nov. 26 to approve bonds in such amount for project. Burns & McDonnell Engineering Corporation, 107 West Linwood Boulevard, Kansas City, Mo., is consulting engineer.

N. Y., Buffalo—Curtiss-Wright Corporation, 30 Rockefeller Plaza, New York, N. Y., manufacturer of airplanes, plans installation of electric power equipment in proposed new plant in vicinity of municipal airport at Buffalo, where site is being acquired, to be used for production of bomber planes for Federal Government. It will consist of several large one-story structures. Entire project estimated to cost close to $6,000,000.

N. Y., Farmingdale—Republic Aviation Corporation, Conklin Street, Farmingdale, L. I., plans installation of electric power equipment in group of one-story additions to aircraft-manufacturing plant, totaling close to 1,000,000 sq. ft. of floor space. Entire project will cost over $7,500,000.

N. Y., Utica—Savage Arms Corporation, Utica, fire-arms, plans installation of electric power equipment in connection with expansion at plant for production of machine guns for Federal Government. Existing structures will be improved and equipped for this purpose. Cost about $17,600,000 complete, machinery and equipment to be owned by War Department; financing will be provided by Government. Completion is scheduled late in 1941.

Ohio, Troy—City Council is considering new municipal electric power plant. Proposed to use Diesel engine-generator units and accessories. Cost estimated about $100,000. Proposed to have detailed plans prepared soon.

Pa., Womelsdorf—Allegheny Chemical Corporation, Reading, Pa., plans new boiler house in connection with rebuilding of chemical-manufacturing plant at Womelsdorf, near Reading, recently destroyed by fire, comprising group of six one-story buildings. Loss estimated about $100,000, with reconstruction to cost approximately a like amount. Electric power equipment will be installed in manufacturing units.

Wis., Green Bay—Wisconsin Public Service Corporation, Green Bay, is considering expansion and improvements in local Bayside steam-electric generating station, including installation of new turbine-generator unit and accessories, high-pressure boilers and auxiliary equipment. Estimates of cost are being made.

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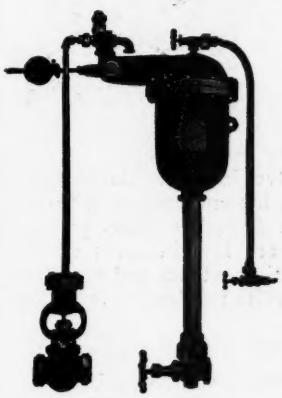

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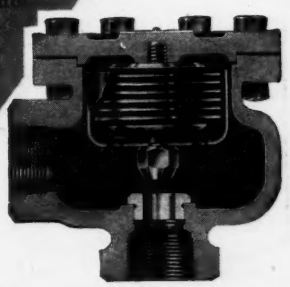

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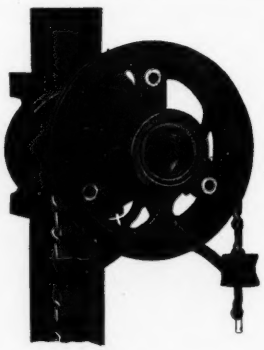

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